Key to the Crayfish of South Carolina

Arnold G. Eversole and Danny R. Jones
Department of Forestry and Natural Resources
Clemson University
Clemson, South Carolina
29634-0315

Sponsor
USDA Forest Service

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Contact person for key distribution:

Jeanne Riley
USDA Forest Service
4931 Broad River Road
Columbia, SC 29212-3530
jriley@fs.fed.us

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Cover photograph: *Cambarus (P.) chaugaensis* by Dan R. Jones

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Abstract

An illustrated key is presented for the five genera and 38 species of crayfish of the subfamily Cambarinae (Decapoda: Cambaridae) found in South Carolina. A generalized life cycle, identification characters with illustrations, and collection methods are outlined in an introduction. The most diverse genus, *Procambarus*, has 17 species in South Carolina, including the introduced *P. clarkii*. Two genera, *Faxonella* and *Fallicambarus*, are represented by one species each, *Distocambarus* by four species, and *Cambarus* by 16 species, including one undescribed species. North American and South Carolina distributions and brief habitat descriptions are provided for each species. The key should be considered a working document because species are continually being added to the list of crayfish occurring in the state.

Introduction

Crayfishes of South Carolina are members of the family Cambaridae, subfamily Cambarinae. Male members of this subfamily possess modified appendages (first pleopod or gonopod) of the first abdominal segment. These pleopods are used to transfer sperm during copulation and are also an essential identification character. Members of this subfamily inhabit a variety of epigian aquatic and semi-aquatic habitats in addition to hypogean terrestrial habitats in South Carolina.

Male members of Cambarinae exhibit cyclic sexual dimorphism associated with the reproductive cycle. Males alternate between a breeding condition (form I or first form) and a non-breeding condition (form II or second form). Form I males, especially in the genus *Cambarus*, exhibit exaggerated secondary sexual characteristics such as enlarged chelae, carapaces, increased spination, and modification of the gonopods. There is anecdotal evidence to suggest that females may undergo a similar transformation. The morphology of form II males more closely approximates the juvenile state.

Form I males in the population molt at the end of the breeding season into form II males, and may remain in this state until the start of the next breeding season, which is indicated by a semi-annual molt returning males into the breeding stage. Most of the male population may be in the form II stage in the period between breeding seasons, which can last through the summer in South Carolina. The periodicity of the annual reproductive cycle is less pronounced in South Carolina than in higher latitudes and frequently, both form I and form II males are found in the same population. It is not unusual to find both form I and form II males in the same population throughout the year.

Identification

The key presented includes 38 crayfish species reported to occur in South Carolina (Cooper 2001). This list includes several endemic species, one introduced species, and undescribed species. Some of the taxa included may represent species complexes that could include currently undescribed species. Because the subspecies taxon is not recognized by all crayfish taxonomists, no attempt is made here to recognize subspecies. Attention is called in the key to these taxonomic uncertainties and some of our efforts to resolve taxonomic problems.

Identification characters and standard measurements used in the key are summarized in Figures 1-5. Use of this key requires an understanding of the distinguishing characteristics of form I males and the terminal structures of the first pleopod. The presence of one or more corneous terminal elements on the distal end of the first pleopod identifies a form I male; juvenile and form II male first pleopods lack corneous terminal elements. The corneous portion of the pleopod of form I males ranges from brown to golden and is shiny, whereas the terminal elements of form II male first pleopods are less defined, more bulbous or "rounded" than the terminal elements of form I males and rarely are brown or golden. Figure 5 contrasts form I and form II terminal elements of first pleopods of representative species of the genera found in South Carolina.

The first pleopods extend from the base of the abdomen forward (cephalad) between the bases of the pereiopods and lie against the sternum of the cephalothorax (Fig. 2). The first pleopod should be considered a hanging pendant from the abdomen when identifying crayfish. The attached end is proximal to the free or distal end while the side facing the head is referred to as the cephalic end and the caudal end faces the telson. The side of the pleopod facing the corresponding pleopod of the pair is mesial while the lateral side faces away from the body midline. Members of the genus *Procambarus* have three or more first pleopod terminal elements while most members of the other four

genera found in South Carolina have only two (mesial process and central projection) terminal elements (Fig. 4).

Form I male cheliped shape and structure is also particularly useful in identifying genera and subgenera of South Carolina crayfish, notably in the genus *Cambarus*. Unfortunately, a proportion of the crayfish in a population frequently loses and regenerates chelipeds during their lifespan. Since regenerated appendages seldom are perfect replicas of original appendages, care must be exercised when one of the pair chelipeds is markedly different. Select a cheliped as an identification character that is similar to the chelipeds of other individuals in the population.

Collecting crayfish

Because crayfish occur in a variety of habitats and exhibit diverse behaviors, no single sampling method will be equally effective collecting representatives of the species in a habitat. In shallow streams with little vegetation, small seines (e.g., $\frac{1}{8}$- or $\frac{1}{4}$-inch mesh), heavily weighted with lead on the lower edge and attached to brail poles can be used. Setting the seine downstream a few meters from a riffle area and disturbing the substrate in the riffle is effective in capturing crayfish that are washed or swim downstream. Pulling the seine across pools and smooth bottom areas is also effective. A large dip net can be used in streams with aquatic vegetation, undercut banks, and stick and leaf racks, but dip nets are less effective with the larger, faster individuals in the population. Baited traps (e.g., minnow traps) capture the larger and more aggressive individuals in a population and work well in deep water and areas with dense vegetation. A facemask and snorkel are helpful in waters clear enough to see crayfish. Burrowing crayfish that never or seldom invade open water can be collected by excavating the burrows with a garden trowel, a shovel, or by hand. Traps have been used with some degree of success to collect burrowing crayfish, especially during warm humid weather. Capture success improves greatly near dusk or at night because crayfish are more active at this time of day. Stream dwelling and

burrowing crayfish can be spotted and collected at night because their eyes glow under flashlight. Please take care to collect only enough representative specimens for identification, especially where crayfish populations appear to be of limited size.

Crayfish specimens should be preserved immediately in an 80% concentration of ethyl alcohol. Alternatively, specimens can be fixed in a 40% concentration of isopropyl alcohol, or in a solution of 5-10% formalin. These preservatives are generally inferior, because over time specimens preserved in isopropyl and formalin solutions become extremely brittle, limiting their usefulness for examination. After one or two days, specimens preserved in formalin should be washed thoroughly (e.g., at least 1-2 hour soak in fresh water), and transferred to 70% ethyl or 40% isopropyl alcohol. Specimens preserved in either type of alcohol should be transferred to fresh alcohol solutions (70 – 80%) after one or two days. Care should be exercised to avoid overcrowding specimens in a field container, because specimens may not be properly preserved. Please note that preservation in alcohol permanently alters and eventually removes all coloration in crayfishes. If color or color patterns are important, or if the specimens are to be photographed, either fix the specimens in formalin or transport them live to the laboratory, where they can be frozen and retained for later examination. After freezing and thawing, specimens can then be preserved using alcohol.

Each collection should be accompanied with a detailed collection label. Collection labels should contain, at a minimum, the following information: state and county of collection; collection site locality, referenced to some permanent feature such as road crossing or distance along a road from a fixed point; estimated bearing and distance from the nearest town, major roadway intersection, or stream confluence; names of all collectors present; date of collection; and taxa collected if known. Field labels should be written on at least 50% bond or rag paper using a pencil or alcohol and waterproof pen. Collection labels should be placed in the collection jar, not written on labels attached to the

jars or on the lids. Latitude and longitude (obtained from a GPS) are useful if collection of that information is possible, but these do not take the place of good collection locality information. It takes just a few minutes to record the minimum information listed above, but it is time well spent. Poor locality and collection information renders a collection virtually useless and reduces your hard work to a waste of time. Additionally, a record of your collection should be kept separately in a field notebook that can include more detailed collection information such as water levels, collecting methods, and other taxa observed. A few representative specimens should always be retained as vouchers of your collection should questions arise concerning the validity of your information.

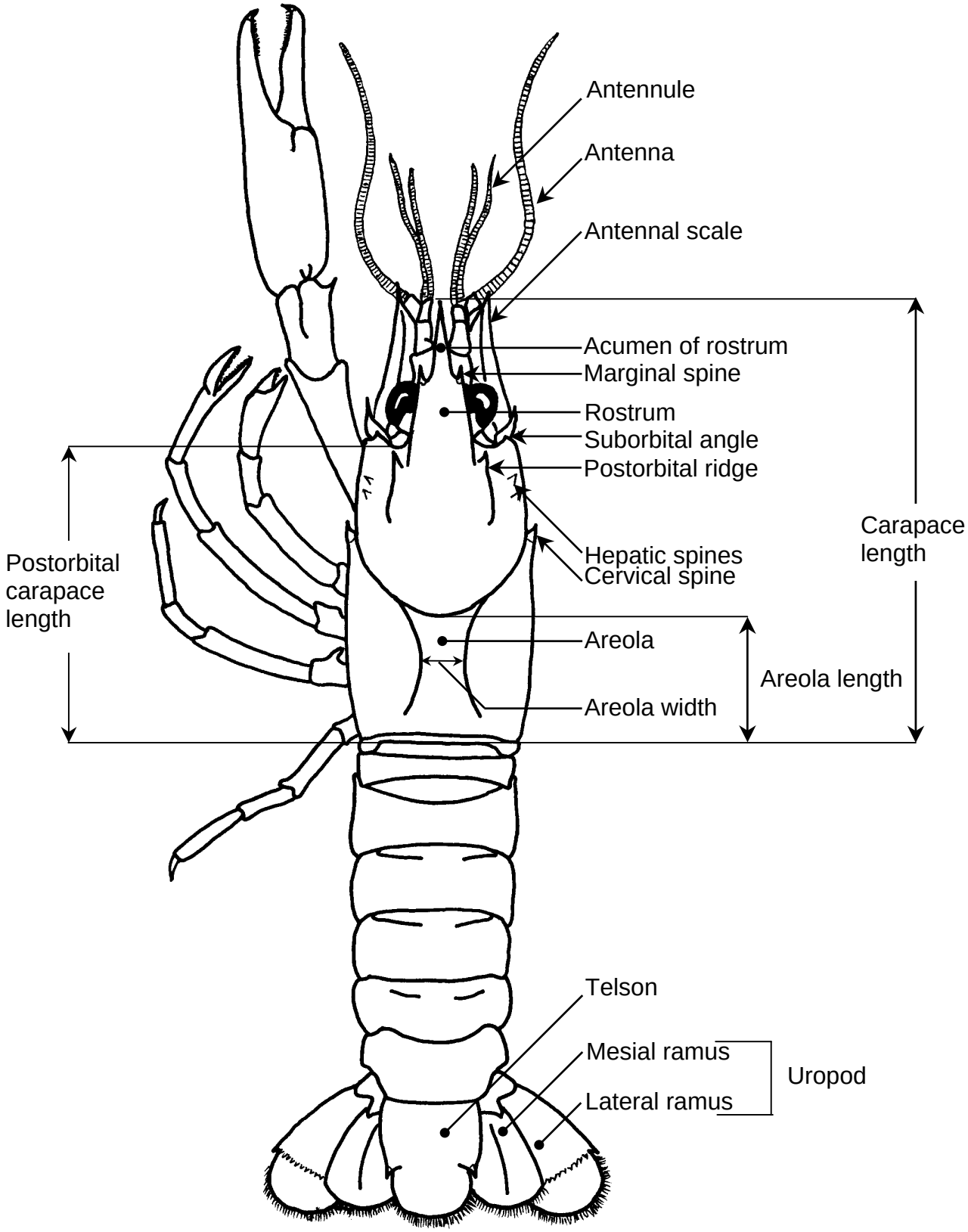


Figure 1. Dorsal view of generalized male crayfish (Redrawn from Hobbs 1976).

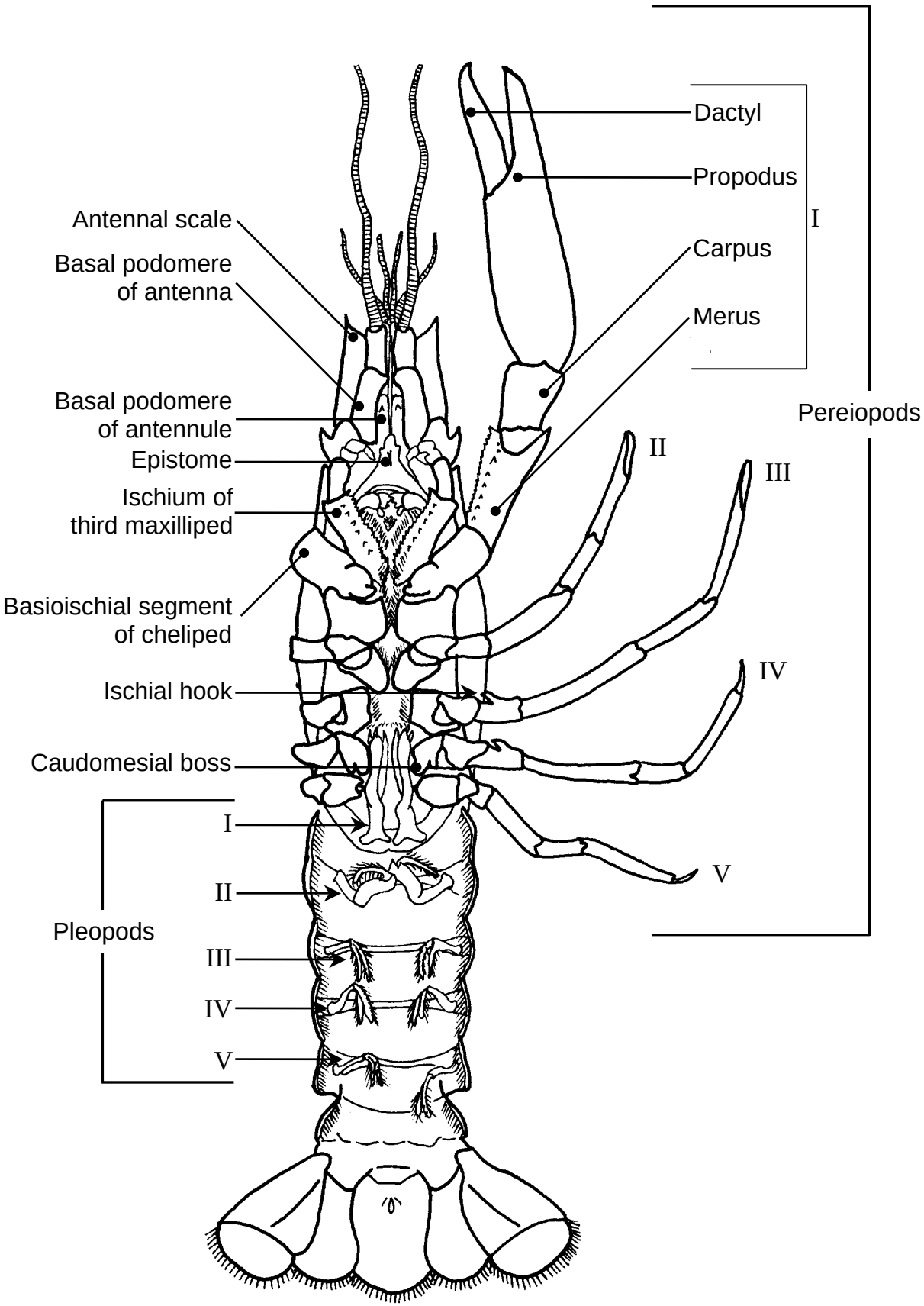


Figure 2. Ventral view of generalized male crayfish (Redrawn from Hobbs 1976).

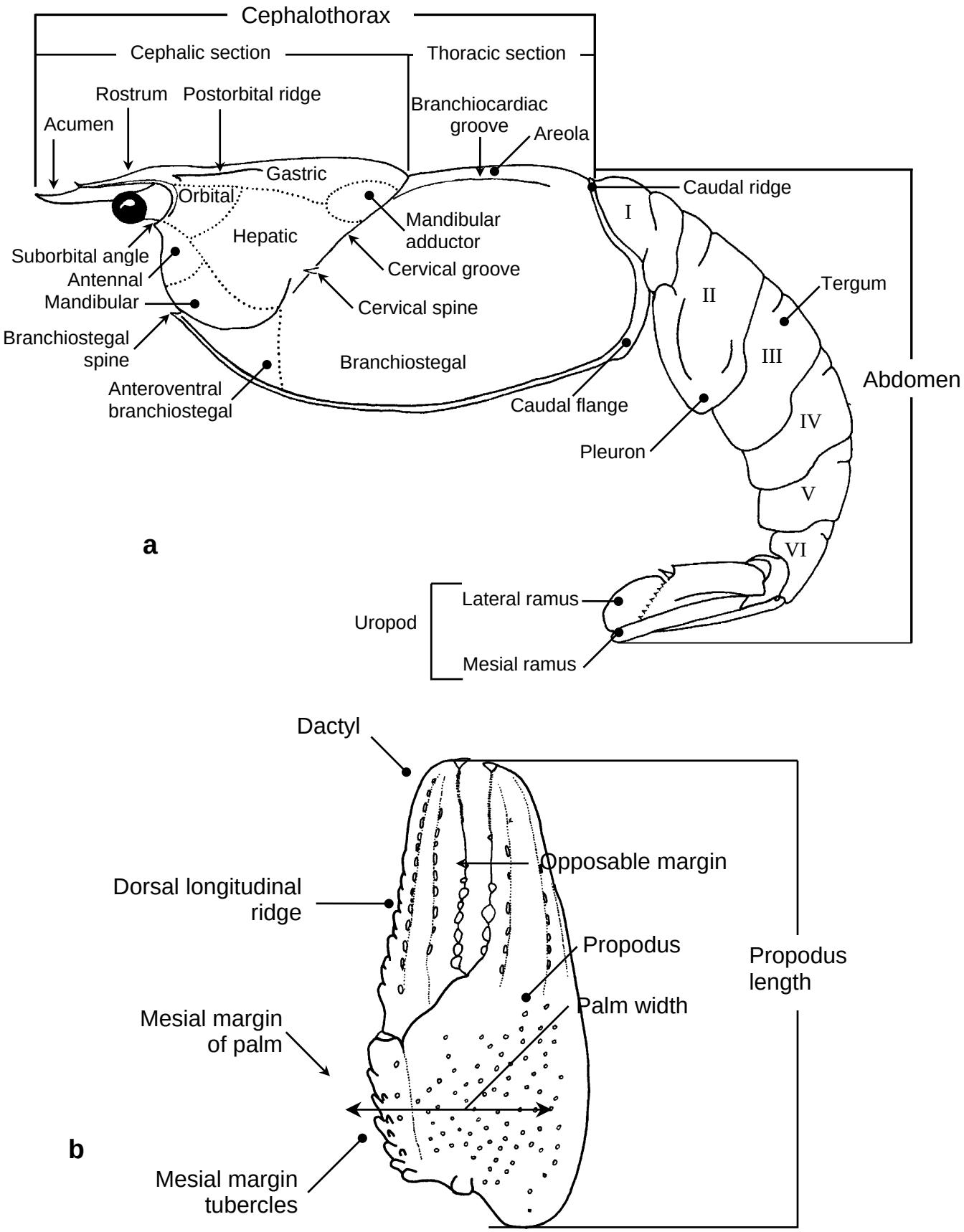


Figure 3. Body regions and features used in identification of crayfishes: a, lateral view of carapace and abdomen; b, dorsal view of right chela. (Redrawn from Hobbs 1981, Prins and Hobbs 1972)

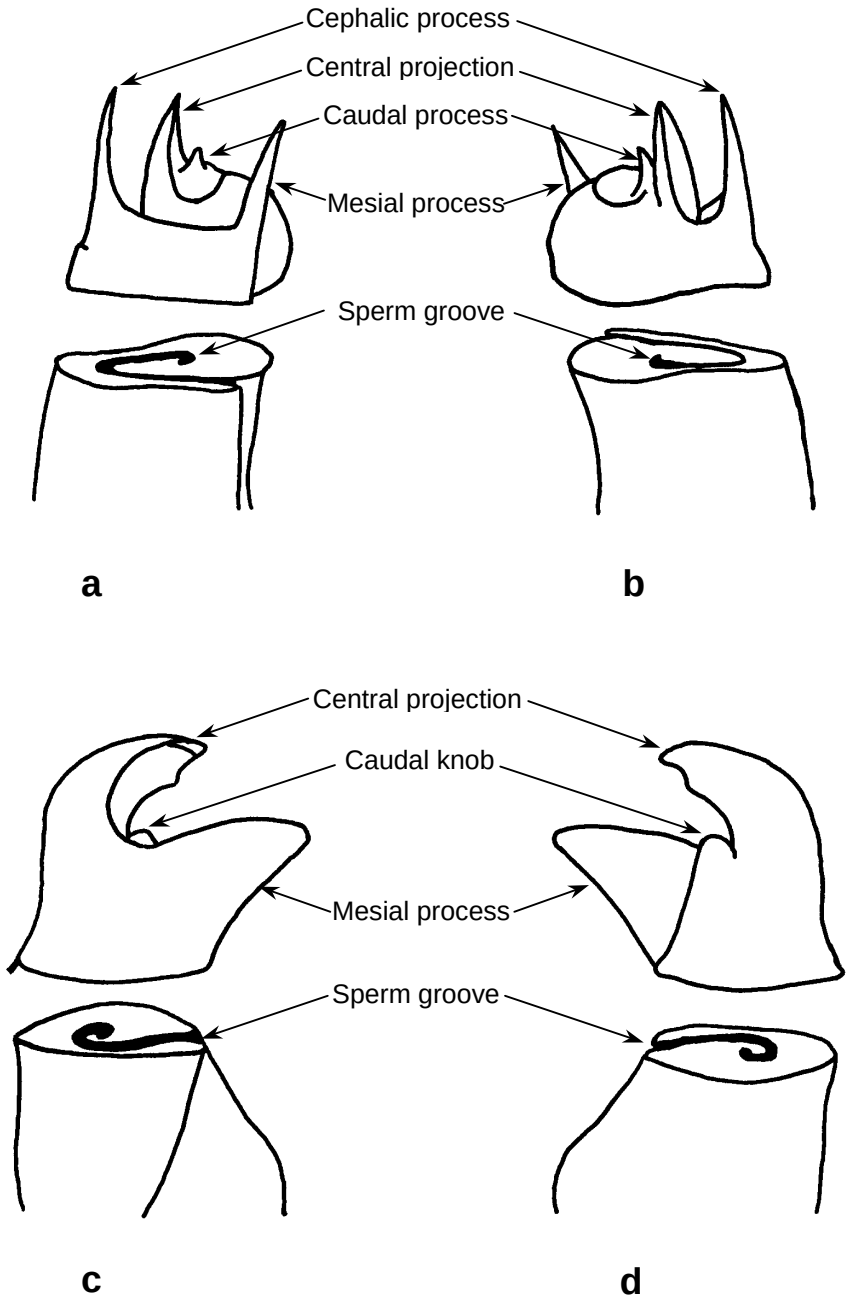


Figure 4. Generalized first pleopod of male members of subfamily Cambarinae. a,b, mesial and lateral views of the distal end of first pleopod of generalized *Procambarus* species; c,d, mesial and lateral views of first pleopod of generalized *Cambarus* species. (Redrawn from Hobbs, 1976)

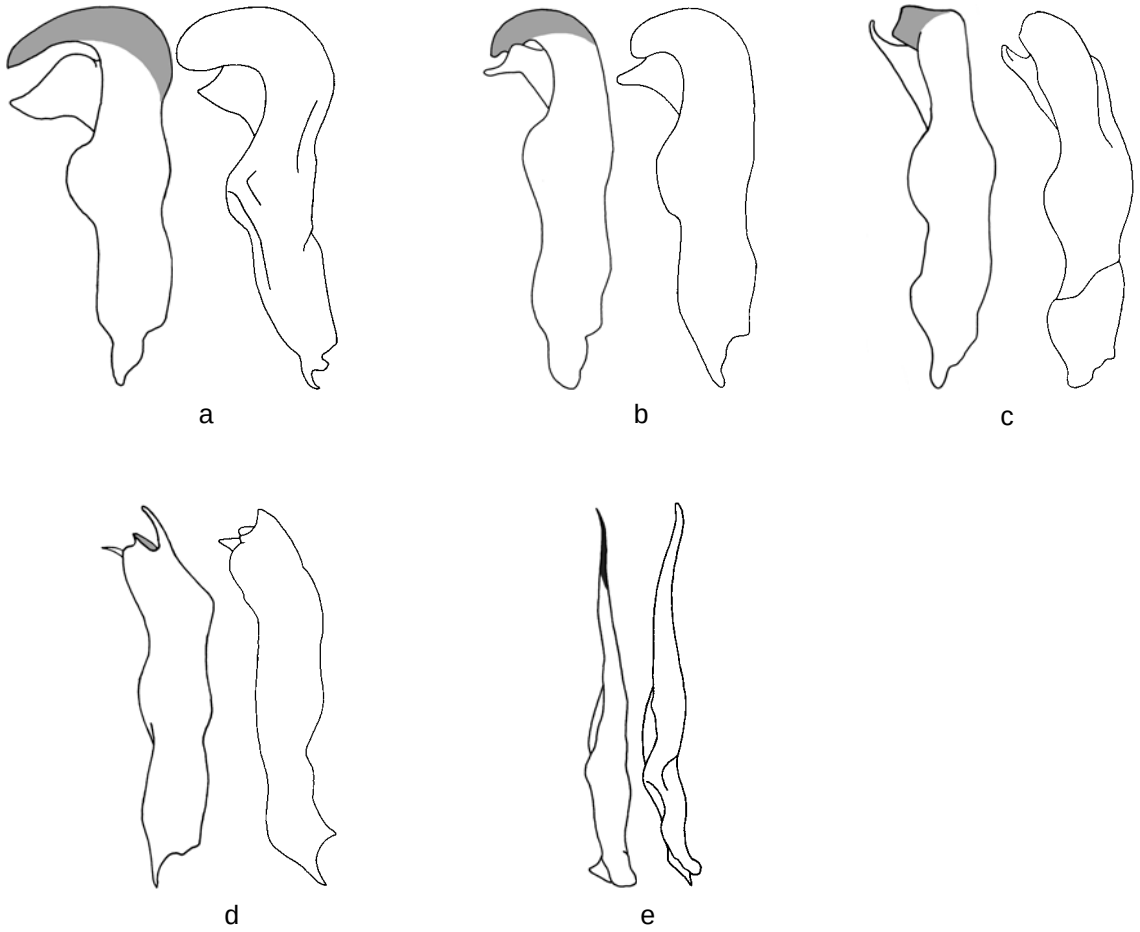


Figure 5. First pleopods of male members of subfamily Cambarinae, a-d, lateral views of the left pleopods of first and second form males, respectively, with corneous central projection shaded in *Cambarus* (a), *Fallicambarus* (b), *Distocambarus* (c), *Procambarus* (d); (e), caudal view of left pleopods of first and second form males, respectively, in *Faxonella.* (Redrawn from Hobbs 1976,1989; Hobbs and Bouchard 1973; Hobbs and Carlson 1983).

Provisional list of crayfish species occurring in South Carolina

1. *Cambarus* (*Cambarus*) *bartonii* (Fabricius, 1798).....Appalachian brook crayfish
2. *Cambarus* (*Cambarus*) *howardi* Hobbs and Hall 1969
3. *Cambarus* (*Depressicambarus*) *latimanus* (LeConte, 1856)
4. *Cambarus* (*Depressicambarus*) *reduncus* Hobbs, 1956
5. *Cambarus* (*Depressicambarus*) *reflexus* Hobbs, 1981
6. *Cambarus* (*Depressicambarus*) *striatus* Hay, 1902
7. *Cambarus* (*Hiaticambarus*) sp. nov. B (in the undiagnosed *C*. (*H*.) *longirostris* complex)
8. *Cambarus* (*Jugicambarus*) *asperimanus* Faxon, 1914
9. *Cambarus* (*Jugicambarus*) *carolinus* (Erichson, 1846)
10. *Cambarus* (*Jugicambarus*) *nodosus* Bouchard and Hobbs, 1976
11. *Cambarus* (*Lacunicambarus*) *diogenes* Girard, 1852
12. *Cambarus* (*Puncticambarus*) *acuminatus* Faxon, 1884
13. *Cambarus* (*Puncticambarus*) *chaugaensis* Prins and Hobbs, 1972
14. *Cambarus* (*Puncticambarus*) *robustus* Girard, 1852
15. *Cambarus* (*Puncticambarus*) *spicatus* Hobbs, 1956
16. *Cambarus (Puncticambarus) hobbsorum* Cooper 2001*
17. *Distocambarus* (*Distocambarus*) *crockeri* Hobbs and Carlson, 1983
18. *Distocambarus* (*Fitzcambarus*) *carlsoni* Hobbs, 1983.....mimic crayfish
19. *Distocambarus* (*Fitzcambarus*) *hunteri* Fitzpatrick and Eversole, 1997
20. *Distocambarus* (*Fitzcambarus*) *youngineri* Hobbs and Carlson, 1985
21. *Fallicambarus* (*Creaserinus*) *fodiens* (Cottle, 1863)
22. *Faxonella clypeata* (Hay, 1899)
23. *Procambarus* (*Leconticambarus*) *barbatus* (Faxon, 1890)
24. *Procamrus* (*Ortmannicus*) *acutus* (Girard, 1852).....”eastern” white river crayfish
25. *Procambarus* (*Ortmannicus*) *ancylus* Hobbs, 1958
26. *Procambarus* (*Ortmannicus*) *blandingii* (Harlan, 1830)
27. *Procambarus* (*Ortmannicus*) *braswelli* Cooper, 1998
28. *Procambarus* (*Ortmannicus*) *chacei* Hobbs, 1958

29. *Procambarus* (*Ortmannicus*) *enoplosternum* Hobbs, 1947
30. *Procambarus* (*Ortmannicus*) *hirsutus* Hobbs, 1958
31. *Procambarus* (*Ortmannicus*) *lepidodactylus* Hobbs, 1947.....PeeDee lotic crayfish
32. *Procambarus* (*Ortmannicus*) *lunzi* (Hobbs, 1940)
33. *Procambarus* (*Ortmannicus*) *pearsei* (Creaser, 1934)
34. *Procambarus* (*Ortmannicus*) *pubescens* (Faxon, 1884)
35. *Procambarus* (*Pennides*) *echinatus* Hobbs, 1956
36. *Procambarus* (*Pennides*) *raneyi* Hobbs, 1953
37. *Procambarus* (*Pennides*) *spiculifer* (Leconte, 1856)
38. *Procambarus* (*Scapulicambarus*) *clarkii* (Girard, 1852).....red swamp crayfish
39. *Procambarus* (*Scapulicambarus*) *troglodytes* (LeConte, 1856)

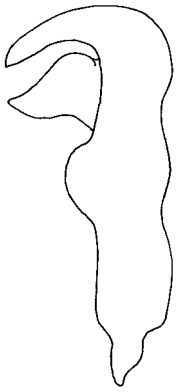
* Recently collected from South Carolina waters in Chester County, South Carolina, and therefore not included in the key.

Key to the South Carolina genera of crayfish
(Based on first form males)

1 First pleopod of male terminating in more than 2 elements ..... ***Procambarus***

1′ First pleopod of male terminating in two elements..... 2

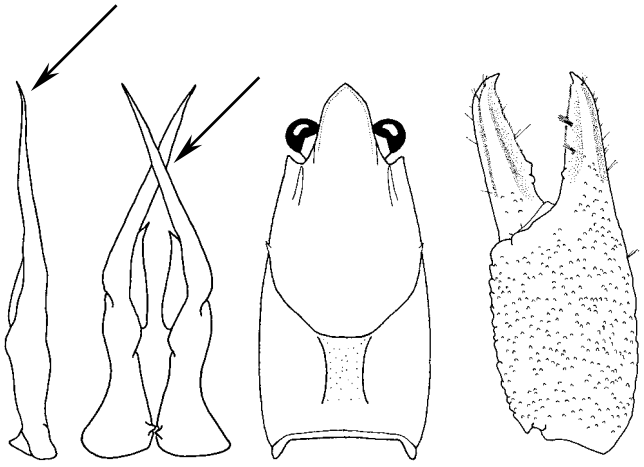
More than 2 elements
Procambarus



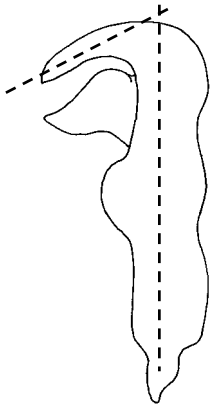
Two elements

2 Central projection long, slender, and directed at angle less than ninety degrees to shaft of pleopod; central projections of pleopods overlap in ventral view .....***Faxonella clypeata*** (Hay,1899)
(From Oklahoma and Texas to the upper coastal plain in South Carolina, including Richland, Lexington, and Aiken counties; found in a variety of aquatic habitats including sluggish streams and lentic habitats)

2′ Central projection usually short, bladelike; directed at angle of ninety degrees or greater to shaft of pleopod..... 3



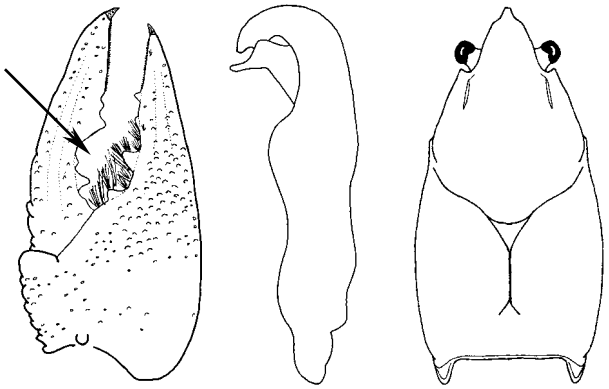
Less than 90º**,** overlapping pleopods
Faxonella clypeata



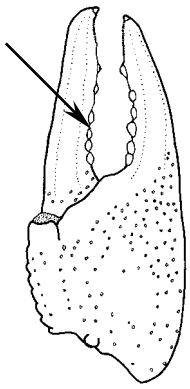
90º or greater

3 Opposable margin of dactyl of chela with an abrupt excision in proximinal half .....***Fallicambarus fodiens*** (Cottle, 1863) (Widespread distribution from southern Canada and Michigan southward to Georgia; burrows and shallow bodies of water in upper coastal plain in Bamberg, Lexington, Marion, Sumter, and Williamsburg counties, South Carolina)

3′ Opposable margin of dactyl of chela without an abrupt excision in the proximal half..... 4



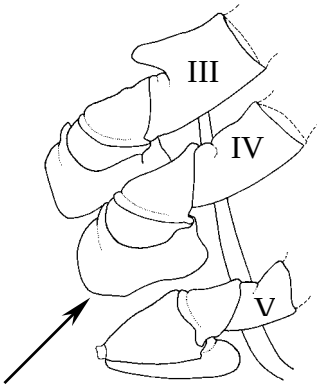
With abrupt excision
Fallicambarus fodiens



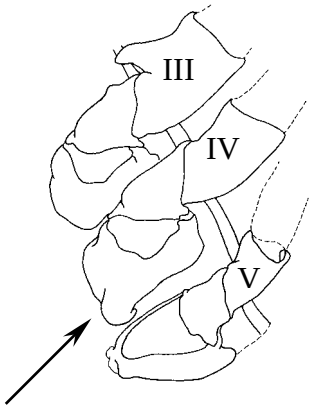
Without abrupt excision

4 Coxae of fourth pereiopods without caudomesial boss ..... ***Distocambarus***

4′ Coxae of fourth pereiopods with caudomesial boss .....***Cambarus***



Without caudomesial boss
Distocambarus

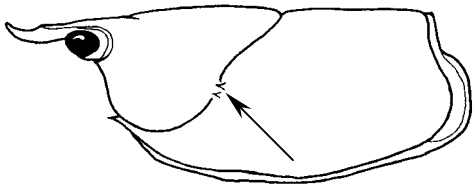


With caudomesial boss
Cambarus

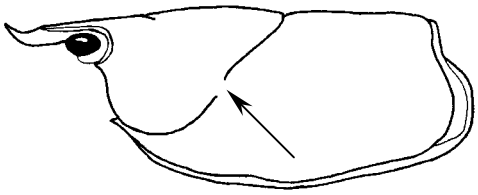
Key to the South Carolina subgenera of genus *Procambarus*
(Based on first form males)

1 Two or more cervical spines present on each side of carapace; first pleopods asymmetrical ..... ***Pennides***

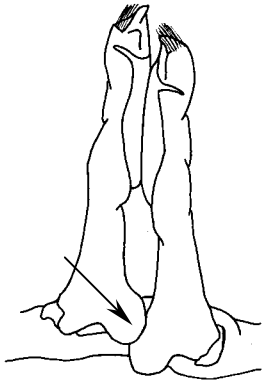
1′ One or no cervical spines on each side of carapace; first pleopods symmetrical 2



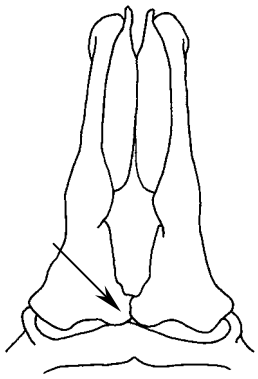
With two cervical spines
Pennides



With no cervical spine



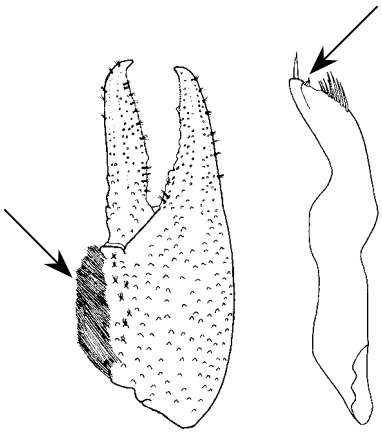
Asymmetric pleopods



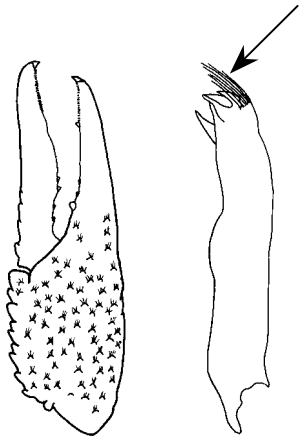
Symmetric pleopods

2 Chelae of first form male (unless regenerated) with mesial surface of palm bearded; male first pleopod with tuft of subapical setae but not obscuring terminal elements.....***Leconticambarus***
.....***Procambarus (L.) barbatus*** (Faxon, 1890)
(Secondary burrower usually found near temporary bodies of water in the coastal plain from Altamaha River, Georgia, to Edisto River South Carolina; recorded from Beaufort, Hampton and Jasper counties, South Carolina)

2′ Chelae of first form male never with mesial surface of palm bearded; subapical setae situated cephalically or laterally partly obscuring terminal elements..... 3



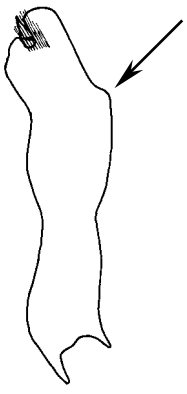
With beard, elements not obscured
Procambarus (L.) barbatus



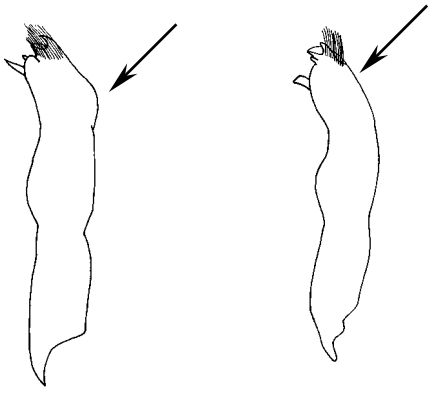
Without beard, elements obscured

3 Cephalic surface of first pleopod with prominent angular or subangular shoulder proximal to the base of terminal elements.....***Scapulicambarus***

3′ Cephalic surface of first pleopod without shoulder or if present, then the shoulder either rounded or near bases of terminal elements ..... ***Ortmannicus***



With angular shoulder
Scapulicambaru

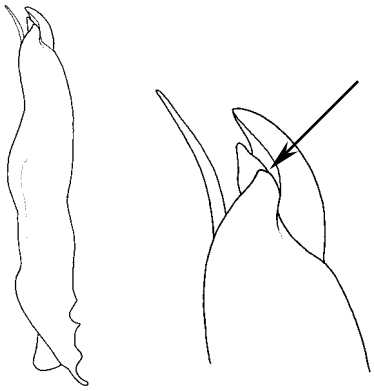


Rounded shoulder No shoulder
Ortmannicus

Key to the South Carolina species of subgenus *Pennides*
(Based on first form males)

1 First pleopod of first form male with well-developed caudal knob .....***Procambarus (P.) spiculifer*** (LeConte, 1856)
(Lotic, lentic; Alabama-Mobile river drainages to Savannah River drainage; Abbeville, Anderson, Oconee and Greenville counties, South Carolina)

1′ First pleopod of first form male with caudal knob greatly reduced or absent..... 2

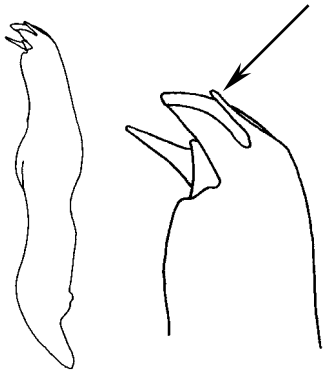


Well-developed
Procambarus (P.) spiculifer

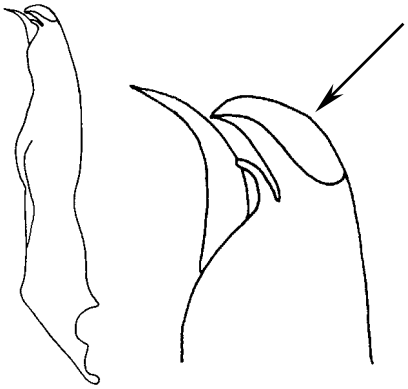
Greatly reduced Absent

2 First pleopod of first form male with well-developed cephalic process .....***Procambarus (P.) echinatus*** Hobbs, 1956
(Streams in Edisto and Salkehatchie river drainages; Aiken, Bamberg and Barnwell counties, South Carolina)

2′ First pleopod of first form male with cephalic process greatly reduced or absent... .....***Procambarus (P.) raneyi*** Hobbs,1953
(Streams in Savannah River drainage; Aiken to Greenville counties, South Carolina)



With cephalic process
Procambarus (P.) echinatus



Without cephalic process
Procambarus (P.) raneyi

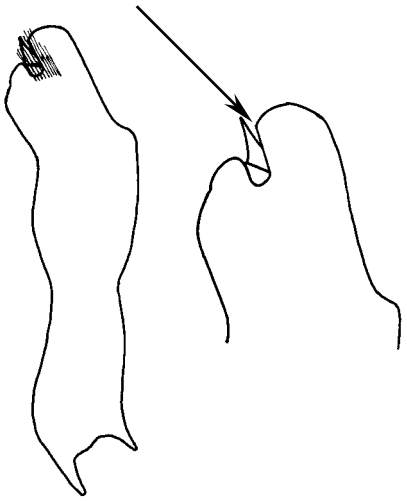
Key to the South Carolina species of subgenus *Scapulicambarus*
(Based on first form males)

1 Caudal margin of cephalic process of first pleopod with a distinct angle

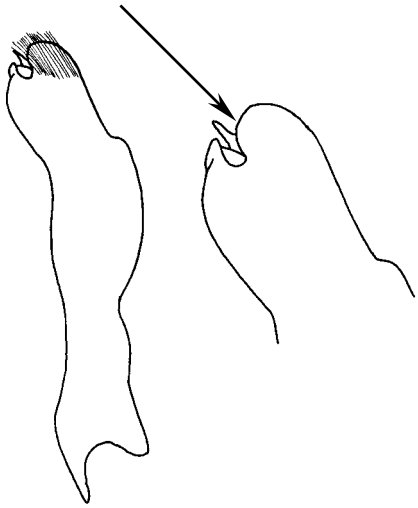
..... ***Procambarus* (*S.*) *clarkii*** (Girard, 1852)
(Introduced in lentic areas in South Carolina as an aquaculture species in the 1970s; a detailed survey of its distribution in South Carolina is warranted)

1' Caudal margin of cephalic process of first pleopod rounded, lacking angle

..... ***Procambarus (S.) troglodytes*** (LeConte, 1856)
(One of the most widely distributed species in the state; occurs in a variety of aquatic habitats from coastal plain counties to lower piedmont counties)



Caudal margin with distinct angle
Procambarus (S.) clarkii

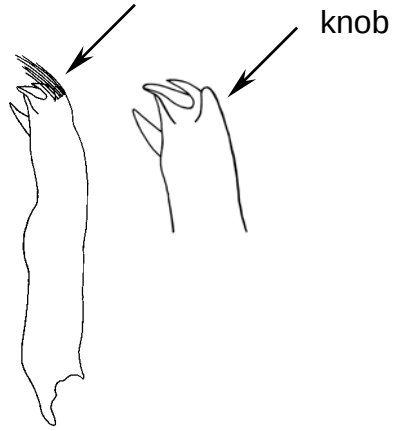


Caudal margin rounded
Procambarus (S.) troglodytes

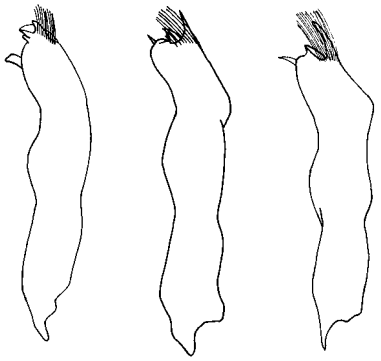
Key to the South Carolina species of subgenus *Ortmannicus*
(Based on first form males)

1 Subapical setae borne on knob on cephalodistal or laterodistal surface of first pleopod..... 2

1′ Subapical setae, if present, never borne on knob..... 3



Subapical setae on knob

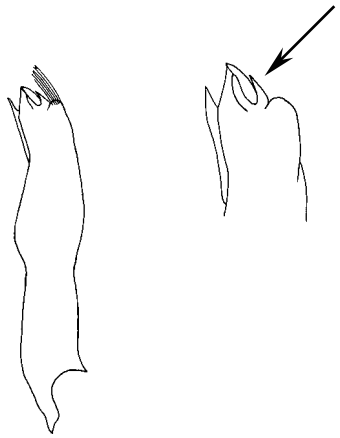


Subapical setae not on knob

2 Cephalic process of male first pleopod with apex directed caudally (Fig. 6a) .....***Procambarus (O.) acutus*** (Girard, 1852) (Sluggish lotic, lentic habitats; coastal plain, piedmont; Georgia to Maine)

2′ Cephalic process of male first pleopod with apex directed distally or caudodistally (Fig. 6c) .....***Procambarus (O.) blandingii*** (Harlan, 1830) (Lotic, lentic habitats from the piedmont to the coastal plain; Santee and Pee Dee river systems; South Carolina and North Carolina)

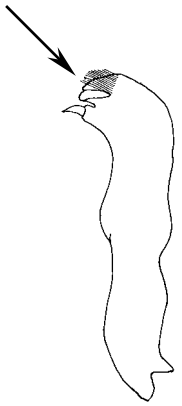
Procambarus*. (*O*.) *acutus



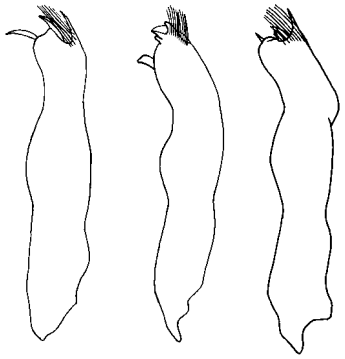
Procambarus*. (*O*.) *blandingii

3 Central projection of first pleopod directed caudally about ninety-degree angle to main axis of pleopod (Fig. 6j) .....***Procambarus* (*O.*) *pearsei*** (Creaser, 1934) (Lentic, burrows; Horry and Marion counties, South Carolina)

3′ Central projection of first pleopod never directed caudally ninety-degree angle to main axis of pleopod. 4



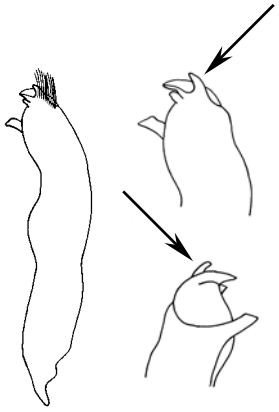
Directed at 90°
Procambarus* (*O.*) *pearsei



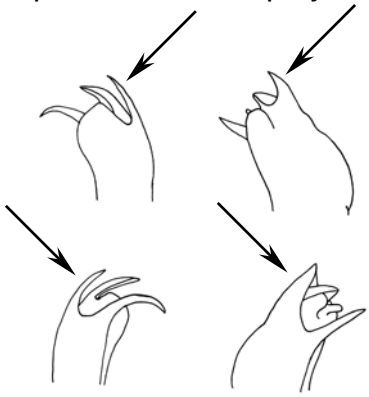
Directed less than 90°

4 Cephalic process of male first pleopod situated distinctly lateral to central projection (Fig. 6h).....***Procambarus* (*O.*) *lepidodactylus*** Hobbs, 1947 (Coastal plain streams of Pee Dee and Santee river systems; South Carolina and North Carolina)

4′ Cephalic process of male first pleopod situated cephalic to central projection 5



Lateral to central projection
Procambarus* (*O.*) *lepidodactylus



Cephalic to central projection

5 Caudal process of first pleopod absent or not evident 6

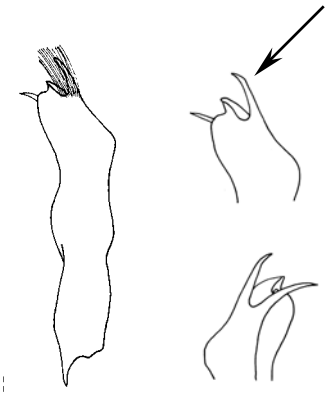
5′ Caudal process of first pleopod small to large, always in lateral aspect 8

Caudal process absent or not evident

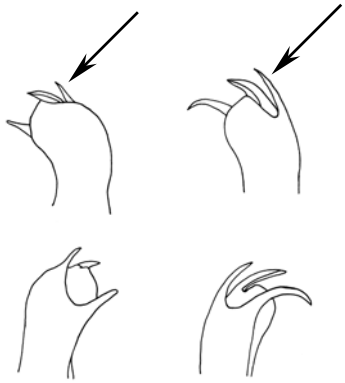
Caudal process present

6 Cephalic process of male first pleopod longer than central projection (Fig. 6g) ....***Procambarus* (*O.*) *hirsutus*** Hobbs, 1958 (Streams in Edisto, Salkehatchie, and Savannah river drainages; coastal plain counties of South Carolina)

6′ Cephalic process of male first pleopod equal to or shorter than central projection 7



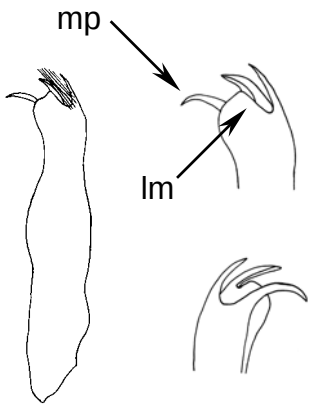
Longer than central projection
Procambarus* (*O.*) *hirsutus



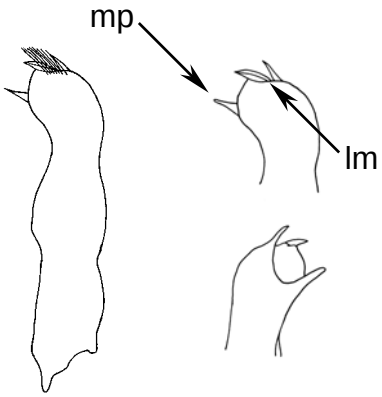
Shorter Subequal

7 Mesial process (mp) of male first pleopod clearly arched caudoproximally; laterodistal margin (lm) of first pleopod at base of central projection steeply oblique (Fig. 6b).....***Procambarus (O.) ancylus*** Hobbs,1958 (Lotic, lentic habitats; coastal counties from North Carolina to Edisto River drainage, South Carolina)

7′ Mesial process (mp) of male first pleopod not arched (especially not caudoproximally); laterodistal margin (lm) of first pleopod at base of central projection almost horizontal (Fig. 6i).....***Procambarus (O.) lunzi*** (Hobbs, 1940) (Lentic and slowing moving lotic waters from Aiken County to Colleton and Jasper counties, South Carolina)



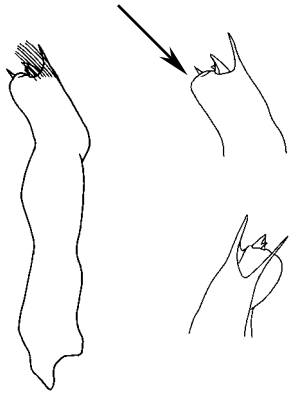
Procambarus* (*O.*) *ancylus



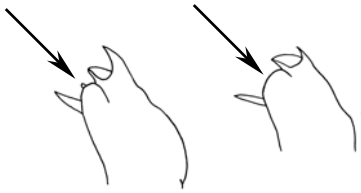
Procambarus* (*O.*) *lunzi

8 Caudal knob of first pleopod truncate and somewhat compressed (Fig. 6k) ..... ***Procambarus* (*O.*) *pubescens*** (Faxon, 1884) (Tributaries to the Oconee, Ogeechee, and Savannah rivers; eastern Georgia, western South Carolina; Aiken, Allendale, Hampton counties, South Carolina)

8′ Caudal knob of first pleopod well developed and inflated..... 9



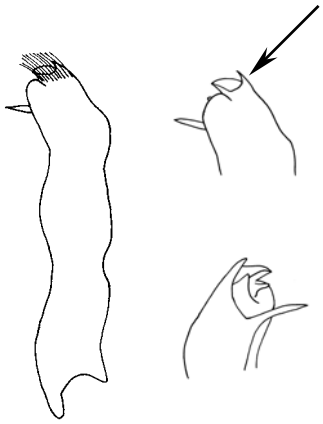
Truncate and compressed
Procambarus* (*O.*) *pubescens



Well developed and inflated

9 Cephalic process of first pleopod much shorter than central projection (Fig. 6f) .... ***Procambarus* (*O.*) *enoplosternum*** Hobbs, 1947 (Streams of lower Oconee and Ohoopee drainages in Georgia to South Carolina counties below the fall line from the Savannah River to the Santee River basin in Richland County, South Carolina)

9′ Cephalic process of first pleopod as long as or longer than central projection 10

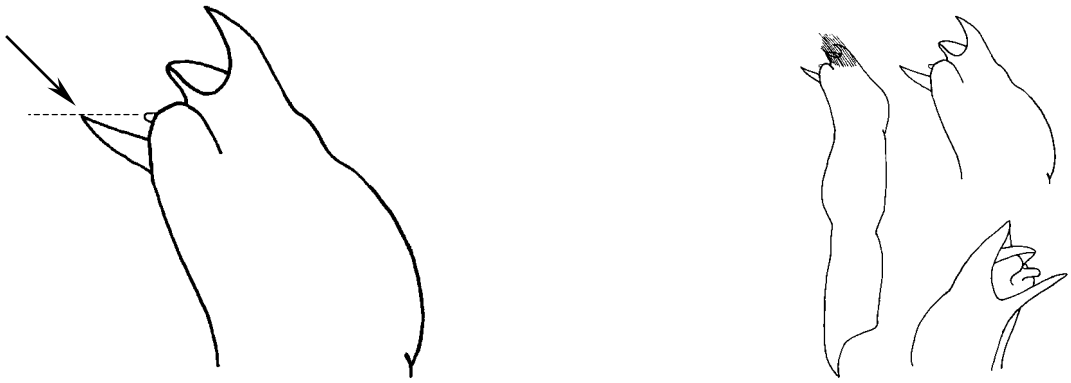


Shorter than central projection
Procambarus* (*O.*) *enoplosternum

As long or longer than central projection

10 Caudal process of first pleopod in lateral aspect projecting caudally from level of caudal knob and would intersect with the mesial process if extended (Fig. 6e) ....***Procambarus* (*O.*) *chacei*** Hobbs, 1958 (Found in upper coastal plain streams from Richland and Calhoun counties in the Wateree River system to Aiken and Barnwell counties bordering the Savannah River in South Carolina into Georgia)

10′ Caudal process of first pleopod in lateral aspect projecting caudally from the caudal knob would not intersect with the mesial process if extended (Fig. 6d) .... ***Procambarus* (*O.*) *braswelli*** Cooper, 1998 (Collected from lentic habitats in the Waccamaw River basin in Columbus County, North Carolina, and Horry County, South Carolina)



Procambarus* (*O.*) *chacei

Procambarus* (*O.*) *braswelli

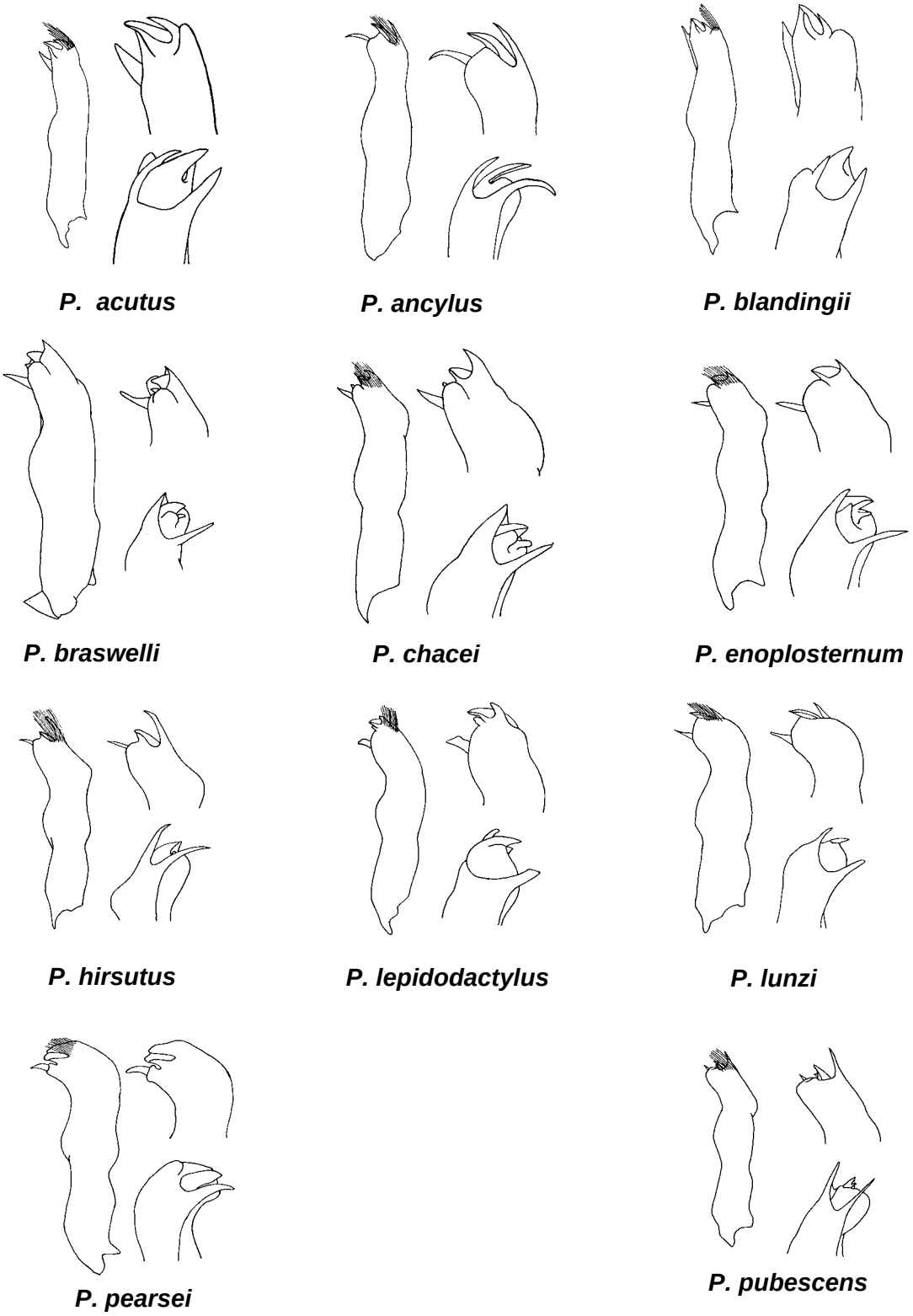
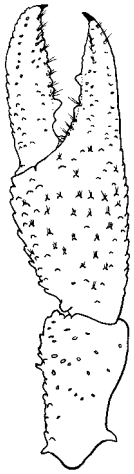


Figure 6. Left pleopod of first form males of members of subgenus *Ortmannicus* occurring in South Carolina; lateral view of entire pleopod (left), lateral view of distal end (upper right), and mesial view of distal end.

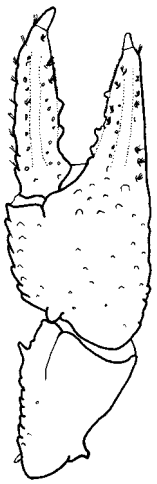
Key to the South Carolina species of genus *Distocambarus*
(Based on first form males)

1 Mesial margin of palm of chela distinctly longer than palm width and at least as long as carpus of cheliped.....
.....***Distocambarus (D.) crockeri*** (Hobbs and Carlson, 1983)
(Primary burrower found from Anderson and Greenville counties south to Edgefield and Lexington counties, South Carolina)

1′ Mesial margin of palm of chela distinctly shorter than palm width and shorter than carpus of cheliped 2



Palm longer
Distocambarus (D.) crockeri



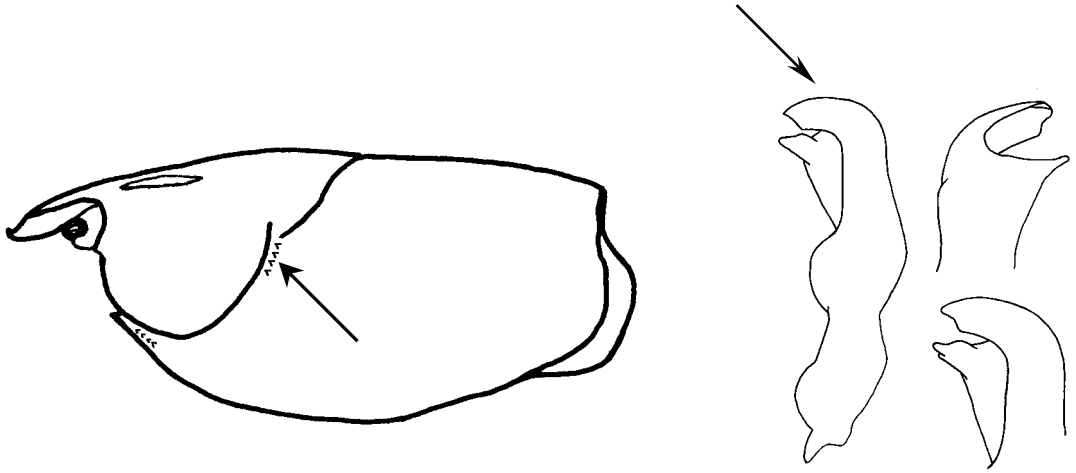
Palm shorter

2 Areola less than 15 times as long as wide with 1 to 2 rows of punctations across the narrowest part; mesial margin cheliped palm with row of 6 to 9 tubercles.....
.....***Distocambarus (F.) hunteri*** Fitzpatrick and Eversole, 1997
(Primary burrower currently found in only a few locations in Saluda County, South Carolina)

2′ Areola at least 15 times as long as wide with no more than 1 row of punctuations across the narrowest part; mesial margin of cheliped palm with row of tubercles less than 7 3

3 Cervical spines or tubercles present; central projection elongate, bladelike, and directed at about ninety degrees to main axis of pleopod; mesial projection directed caudally..... ***Distocambarus (F.) carlsonii*** Hobbs, 1983 (Primary burrower found in the Savannah and Saluda river basins in Abbeville, Greenwood and Saluda counties, South Carolina)

3′ Cervical spines absent; central projection short, broad, subquadrangular and oriented at about forty-five degrees to main axis of pleopod; mesial process directed caudodistally .... ***Distocambarus (F.) youngineri*** Hobbs and Carlson, 1985 (Primary burrower found to date only in Newberry County, South Carolina)



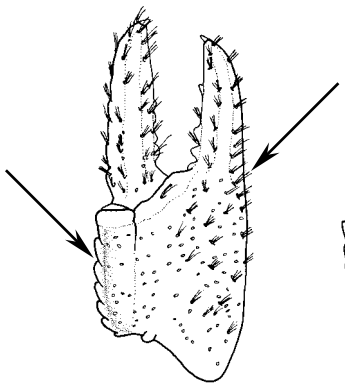
Distocambarus (F.) carlsoni

Distocambarus (F.) youngineri

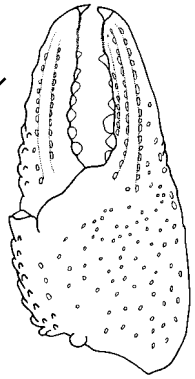
Key to the South Carolina subgenera of genus *Cambarus*
(Based on first form males)

1 Tubercles on mesial surface of palm of chelae forming cristiform (crest-like) or serrate row; if serrate then chelae are subrectangular; palms and fingers of chelae sometimes with long, stiff, conspicuous setae ..... ***Jugicambarus***

1′ Tubercles on mesial surface of palm of chelae never forming cristiform row; if serrate then chelae are subtriangular; palms and fingers of chelae never with long, stiff, conspicuous setae.....2

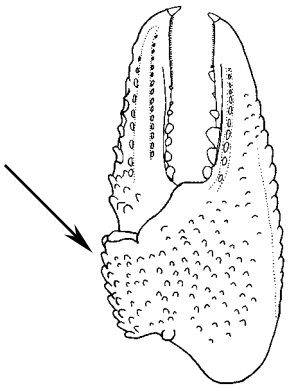


Cristiform row; long stiff setae

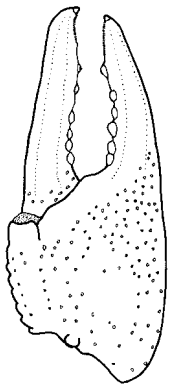


Serrate row, no long stiff setae

Jugicambarus



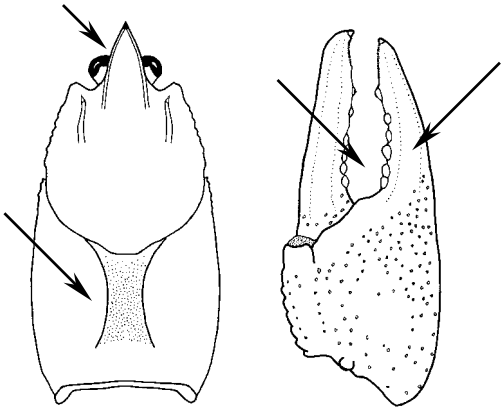
Serrate row, subtriangular



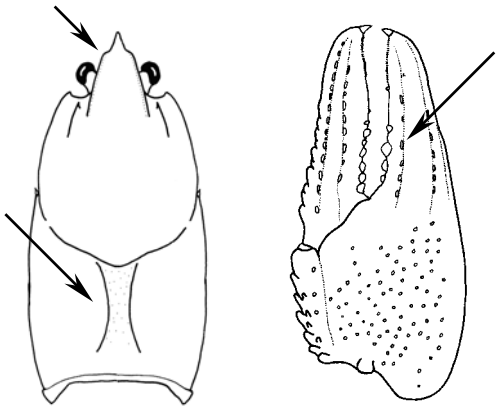
Row not serrate or cristiform

2 Margins of rostrum distinctly thickened; areola with crowded deep punctations; fingers of chelae with poorly defined longitudinal ridges; fingers of chelae strongly gaping; mesial surface of palm of chelae with a single row of low tubercles.....***Hiaticambarus*** ..... ***Cambarus* (*H.*) *sp. nov.***
(Presently known only from three locations in West Fork Little River, Keowee subdrainage of upper Savannah River drainage in Pickens County, South Carolina)

2′ Margins of rostrum rarely thickened; areola lacking crowded deep punctations (except in some members of *Puncticambarus*); fingers of chelae with well-defined longitudinal ridges; fingers of chelae not strongly gaping 3



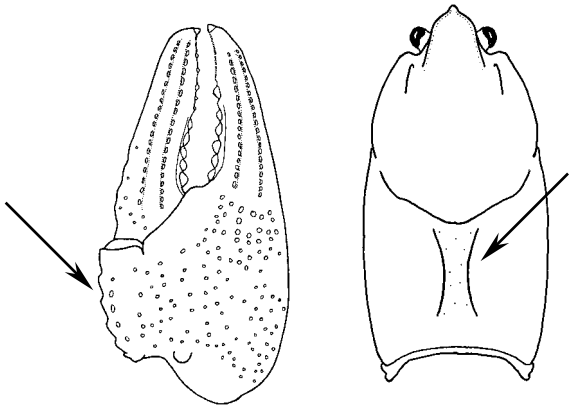
Thick margins, crowded punctuations, poorly defined ridges, strong gape
Cambarus* (*H.*) *sp. nov.



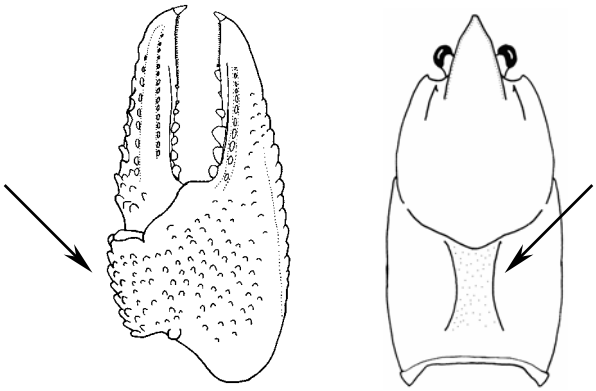
Thin margins, punctations not crowded, well-defined ridges, no gape

3 Mesial surface of palm of chelae with single row of strongly depressed tubercles; areola moderately broad and with sparse punctations .....***Cambarus***

3′ Mesial surface of palm of chelae normally with two or more rows of tubercles, if only one row is present then tubercles are not strongly depressed; areola broad to obliterated, if sparsely punctate then palm of chelae with one or more well-defined rows of tubercles..... 4



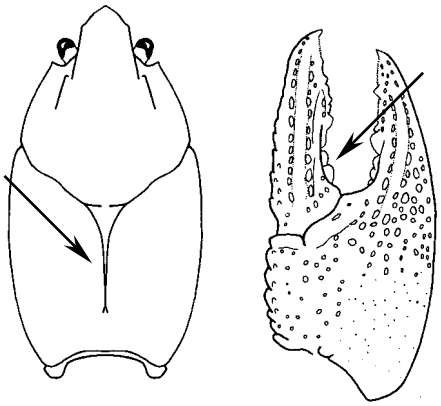
Single row, depressed tubercles, areola sparsely punctuate
Cambarus



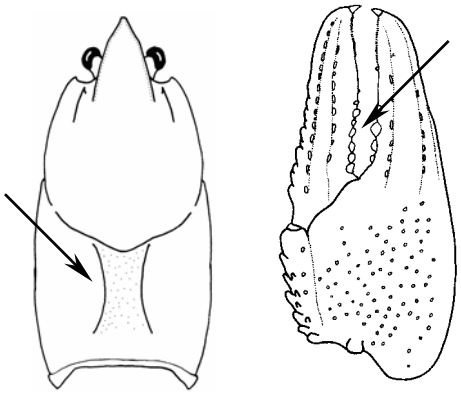
Two rows, strong tubercles, areola with many punctuations

4 Areola obliterated to 28 times as long as broad; dactyl of chelae with broad concavity on basal half of opposable margin; central projection of first pleopod of first form male very short, not tapering, rounded apically .....***Lacunicambarus*** .....***Cambarus* (*L.*) *diogenes*** Girard, 1852
(Primary burrower often found in aquatic habitats in the spring; documented from several coastal plain counties in South Carolina)

4′ Areola variable but rarely obliterated or sublinear; if obliterated or sublinear then dactyl lacks broad concavity on opposable margin; central projection of first pleopod of first form male variable, long or short; if central projection does not taper then central projection always bears subapical notch 5



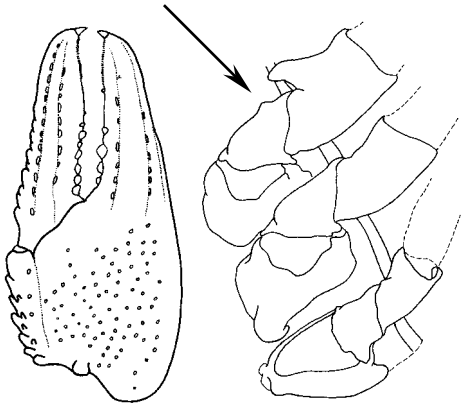
Areola obliterated Broad concavity
Cambarus* (*L.*) *diogenes



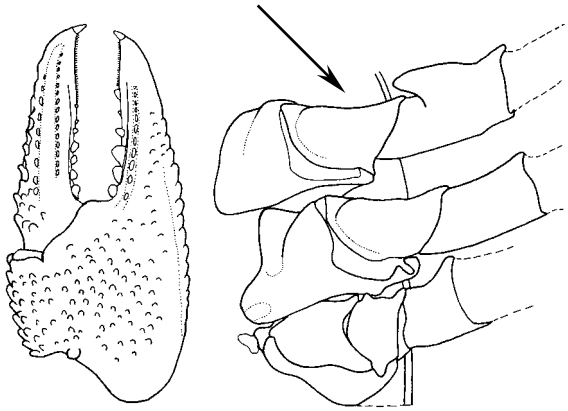
Not obliterated No concavity

5 Width of palm of chelae less than 1.5 times length of mesial margin of palm of chelae; central projection of first pleopod of first form male always bearing subapical notch; basis of third pereiopod almost always with tubercle opposing hook on ischium of appendage..... ***Puncticambarus***

5′ Width of palm of chelae more than 1.5 times length of mesial margin of palm of chelae; central projection of first pleopod of first form male strongly tapering or with subapical notch; basis of third pereiopod rarely with tubercle opposing hook on ischium of appendage ..... ***Depressicambarus***



Palm width < 1.5x length of mesial margin, basis of third pereiopod with tubercle opposing hook on ischium
Puncticambarus

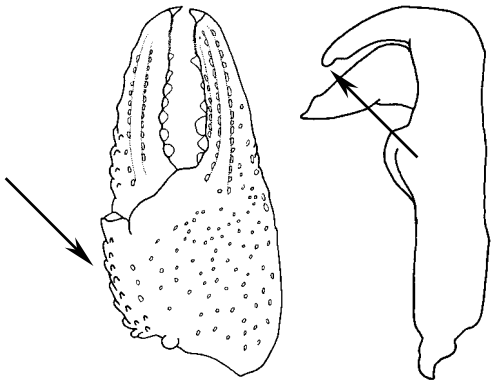


Palm width > 1.5x length of mesial margin, basis of third pereiopod without tubercle opposing hook on ischium
Depressicambarus

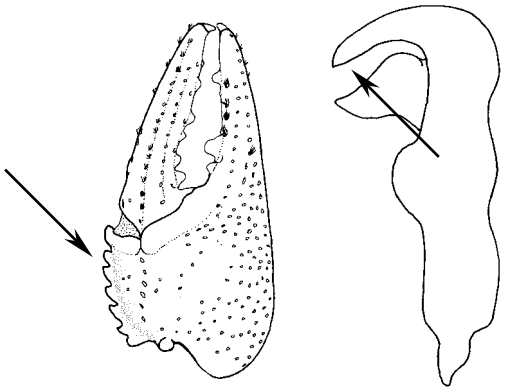
Key to the South Carolina species of subgenus *Jugicambarus*
(Based on first form males)

1 Mesial margin of palm of chelae with two rows of tubercles; central projection of first pleopod with subapical notch..... ..... ***Cambarus (J.) nodosus*** Bouchard and Hobbs, 1976
(Burrows, sometimes in small streams; headwaters and tributaries of the Hiwassee, Savannah, and Chattahoochee river systems in Tennessee, North Carolina, South Carolina, and Georgia)

1′ Mesial margin of palm of chelae with one row of tubercles; central projection of first pleopod without subapical notch..... 2



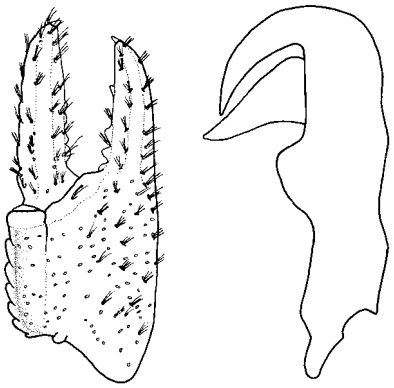
Two rows of tubercles, with subapical notch
Cambarus (J.) nodosus



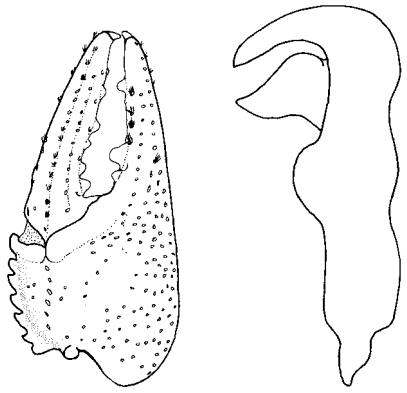
One row of tubercles, without subapical notch

2 Chelae with conspicuous tufts of stiff setae..... .....***Cambarus* (*J.*) *asperimanus*** Faxon 1914
(Seepage areas and mountain streams; mountains of North Carolina, South Carolina, and Georgia, in the headwaters of the French Broad, Little Tennessee, Catawba, Broad, Saluda, and Savannah Rivers systems, and in the Watauga River basin in Tennessee)

2′ Chelae without conspicuous tufts of stiff setae..... ..... ***Cambarus* (*J.*) *carolinus*** (Erichson, 1846)
(Primary burrower; from the upper Broad River basin in northern South Carolina westward into North Carolina and Tennessee almost to the Tennessee River)



With conspicuous setae
Cambarus* (*J.*) *asperimanus

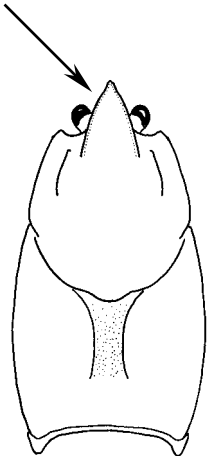


Without conspicuous setae
Cambarus* (*J.*) *carolinus

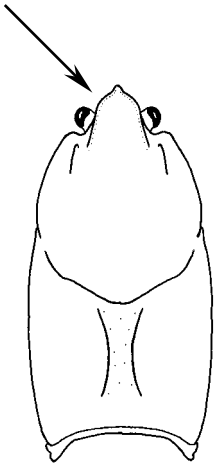
Key to the South Carolina species of subgenus C*ambarus*
(Based on first form males)

1 Rostrum acuminate.....
.....***Cambarus* (*C.*) *howardi*** Hobbs and Hall, 1969
(Hobbs (1989) listed range as "Chattahoochee drainage system from Hall and Lumpkin counties, Georgia, to Lee County, Alabama"; populations in the upper piedmont region of the Carolinas may be assignable to this taxon)

1′ Rostrum with margins abruptly contracted at base of acumen .....
.....***Cambarus* (*C.*) *bartonii*** (Fabricius, 1798)
(New Brunswick, Canada, to northern Georgia and eastern parts of Kentucky and Tennessee to the Atlantic Ocean; restricted to foothills and mountains in South Carolina and Georgia; this taxon shows considerable and perplexing variation across its range, particularly in the southern Appalachian Mountains)



Rostrum acuminate
Cambarus* (*C.*) *howardi

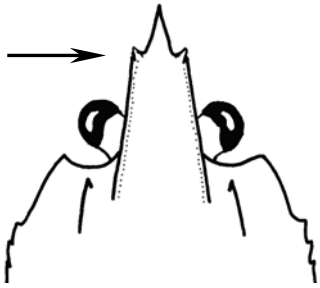


Margins contracted
Cambarus* (*C.*) *bartonii

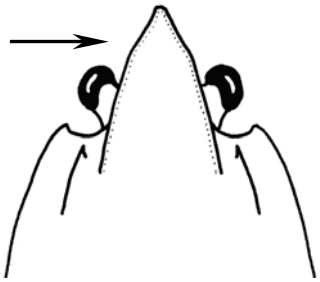
Key to the South Carolina species of subgenus *Puncticambarus*
(Based on first form males)

1 Rostrum with marginal spines..... ***Cambarus* (*P.*) *spicatus*** Hobbs, 1956
(Lotic, Little River drainage in Fairfield and Richland counties, South Carolina)

1′ Rostrum without marginal spines..... 2



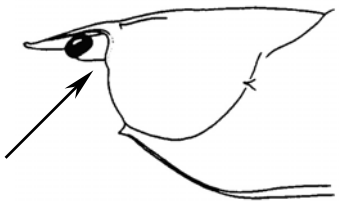
With marginal spines
Cambarus* (*P.*) *spicatus



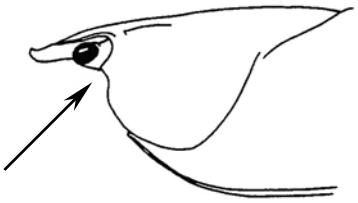
Without marginal spines

2 Suborbital angle absent..... ***Cambarus* (*P.*) *acuminatus*** Faxon, 1884
(Lotic; from the Patapsco River drainage in Maryland south to the Saluda River drainage in South Carolina; this taxon shows a great degree of variation and probably represents a species complex)

2′ Suborbital angle present..... 3



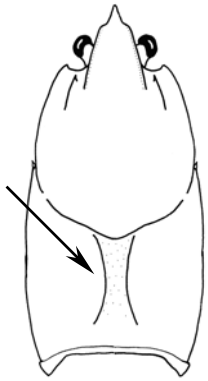
Suborbital angle absent
Cambarus* (*P.*) *acuminatus



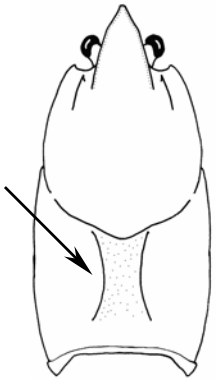
Suborbital angle present

3 Areola more than 3.5 times longer than broad.....
.....***Cambarus* (*P.*) *robustus*** Girard, 1852
(Lotic; widespread, from Ontario and Illinois southward to Virginia, Tennessee, North Carolina, and South Carolina)

3′ Areola less than 3.5 times longer than broad .....
..... ***Cambarus* (*P.*) *chaugaensis*** Prins and Hobbs 1972
(Lotic; tributaries of the Savannah River in Oconee County, South Carolina, and Rabun County, Georgia; most abundant in South Carolina in the Chauga River drainage)



More than 3.5 times longer
Cambarus* (*P.*) *robustus



Less than 3.5 times longer
Cambarus* (*P.*) *chaugaensis

Key to the South Carolina species of subgenus *Depressicambarus*
(Based on first form males)

1 Central projection of first pleopod subsetiform .....
.....***Cambarus* (*D.*) *reduncus*** Hobbs, 1956
(Lotic, lentic, burrows, may be a primary or secondary burrower; Piedmont Province from Orange County, North Carolina, to Richland County, South Carolina)

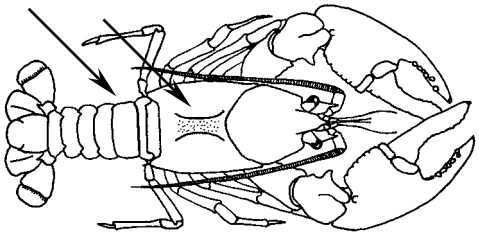
1′ Central projection of first pleopod bladelike 2

Central projection subsetiform
Cambarus* (*D.*) *reduncus

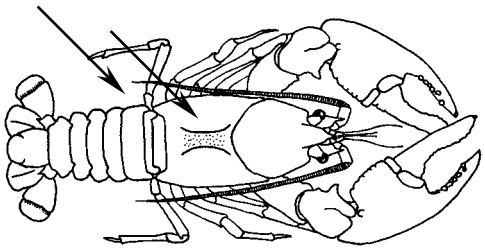
Central projection bladelike

2 Maximum width of abdomen distinctly less than length of areola .....
.....***Cambarus* (*D.*) *reflexus*** Hobbs, 1981
(Primary burrower; coastal plain of the Savannah River drainage through the Santee system in South Carolina and Georgia)

2′ Maximum width of abdomen subequal to or greater than length of areola 3



Abdomen width less
than areola length
Cambarus* (*D.*) *reflexus



Abdomen width greater
than areola length

3 Areola less than 9 times longer than broad, usually comprising less than 37 percent of total carapace length; first pleopod usually lacking caudal knob .... ***Cambarus* (*D.*) *latimanus*** (LeConte, 1856) (Lotic, small to moderately large streams and burrows, secondary burrower; Piedmont and coastal plain from the Tar and Cape Fear systems in North Carolina south to the Altamaha and Appalachicola systems in Georgia and Florida, and west to the Coosa River system in Georgia and Alabama)

3′ Areola more than 9 times longer than broad, usually comprising more than 37 percent of total carapace length; first pleopod usually with caudal knob ....***Cambarus* (*D.*) *striatus*** Hay, 1902 (Lotic, streams and burrows, primary burrower in southern part of range; from the Savannah and Okhlockonee systems in South Carolina, Georgia, and Florida westward into Mississippi and north through Tennessee into the Green River system in Kentucky)

Without caudal knob
Cambarus* (*D.*) *latimanus

With caudal knob
Cambarus* (*D.*) *striatus

Acknowledgments

The key could not have been attempted without Horton H. Hobbs', Jr. contributions to crayfish biology and taxonomy. We freely used terminology and illustrations from several of his sources (see the Literature Cited section) and are fully responsible for any errors in adapting his work to a key for South Carolina crayfishes. Finally we thank Jeanne Riley and the U.S. Forest Service for their support of this project and helping with the initial stages of what we hope will culminate in the book, Crayfishes of South Carolina.

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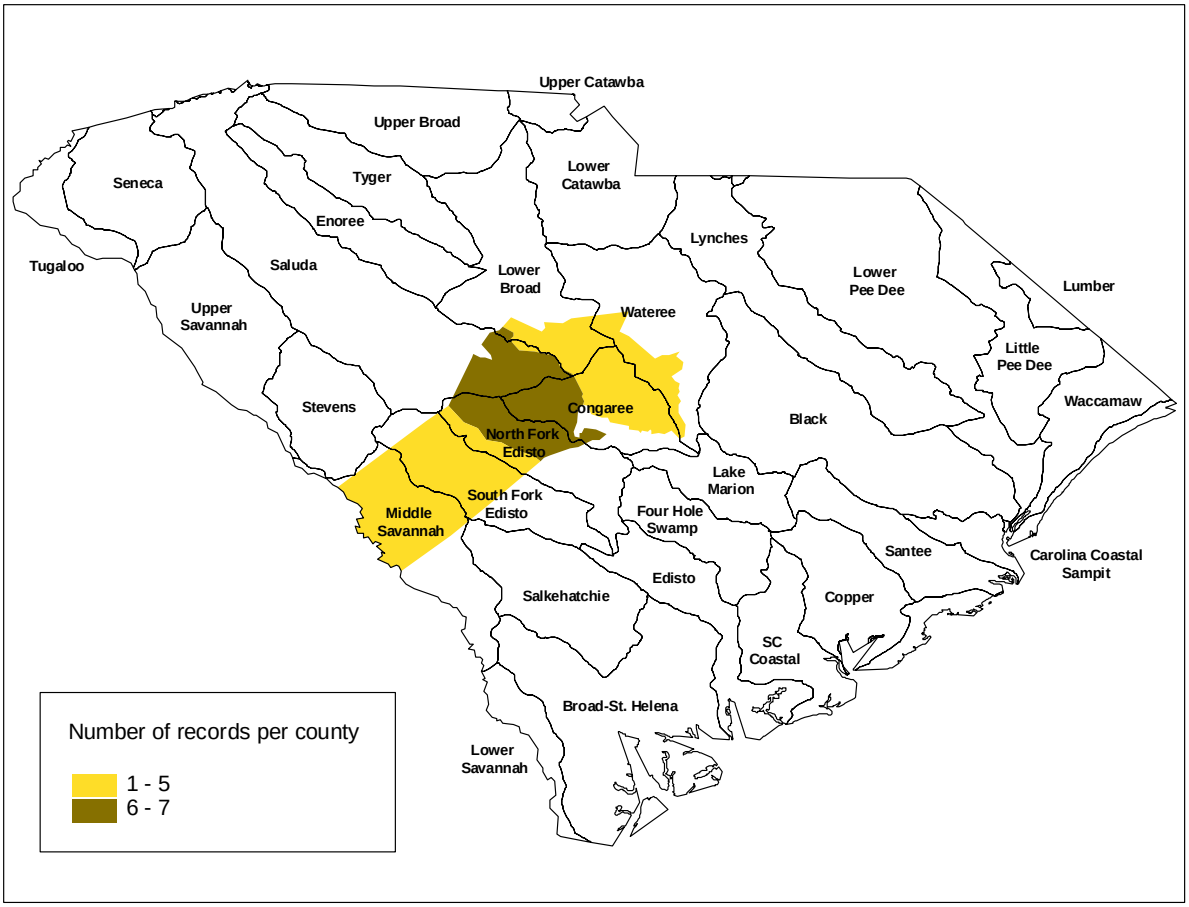

Figure 1. County based distribution of *Faxonella clypeate* within USGS Hydrologic Cataloging Unit Boundaries. Number of records per county based on USNHM and other collection records.

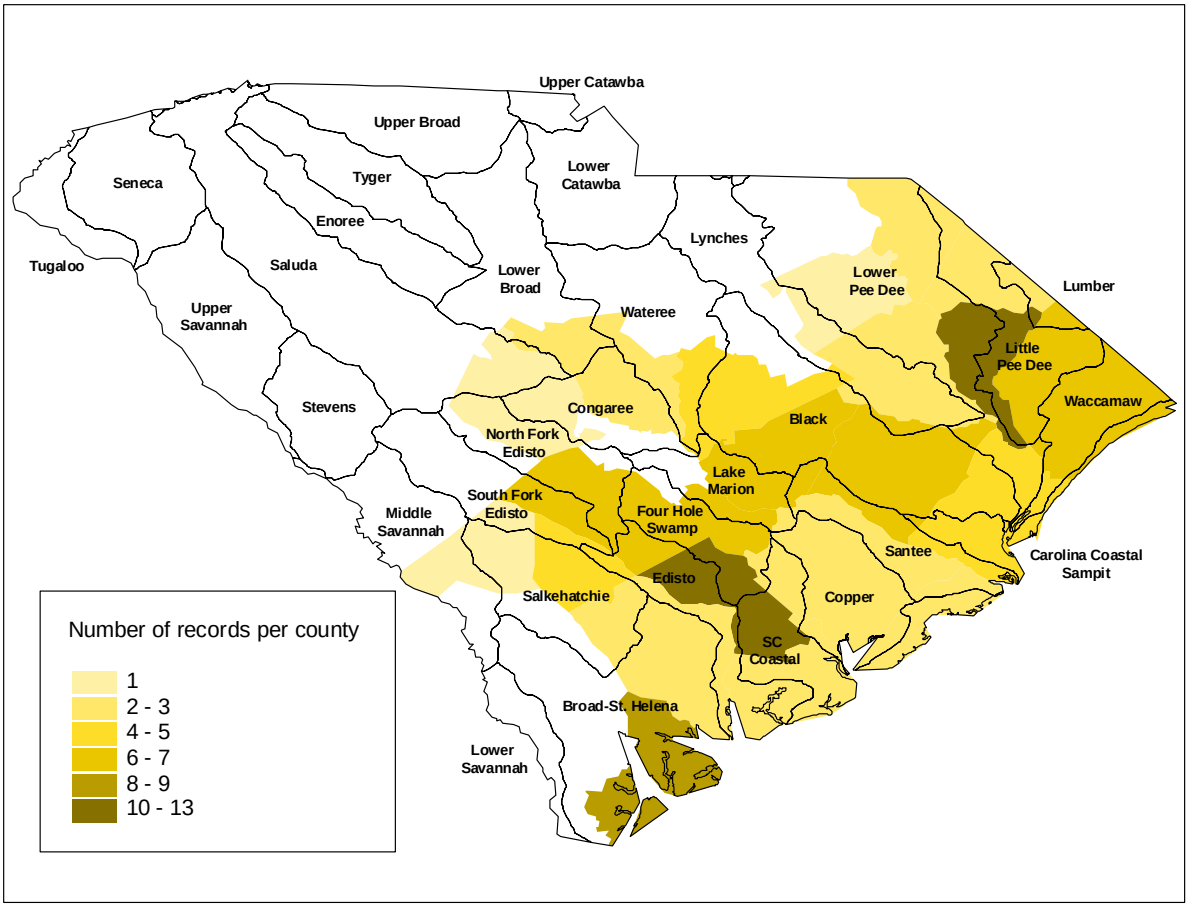

Figure 2. County based distribution of *Fallicambarus fodiens* within USGS Hydrologic Cataloging Unit Boundaries. Number of records per county based on USNHM and other collection records.

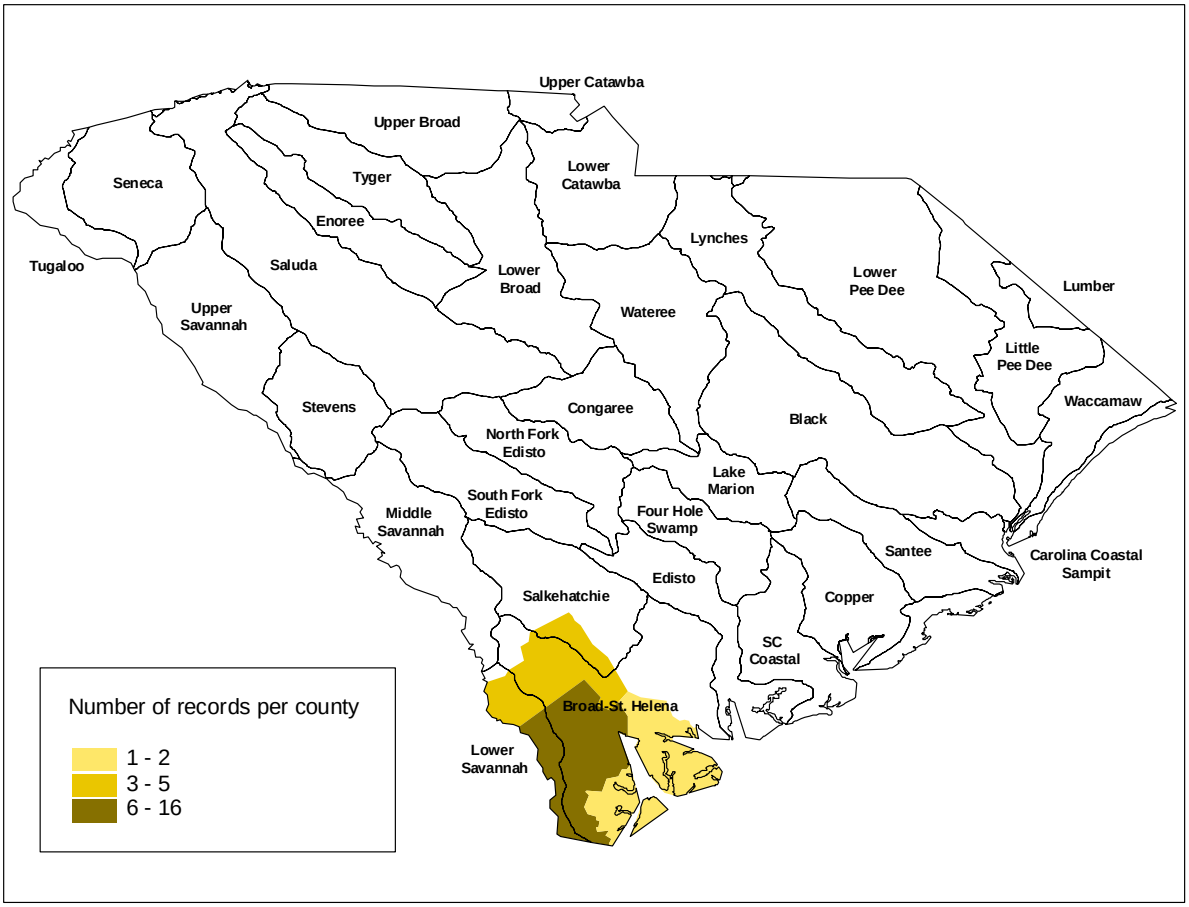

Figure 3. County based distribution of *Procambarus barbatus* within USGS Hydrologic Cataloging Unit Boundaries. Number of records per county based on USNHM and other collection records.

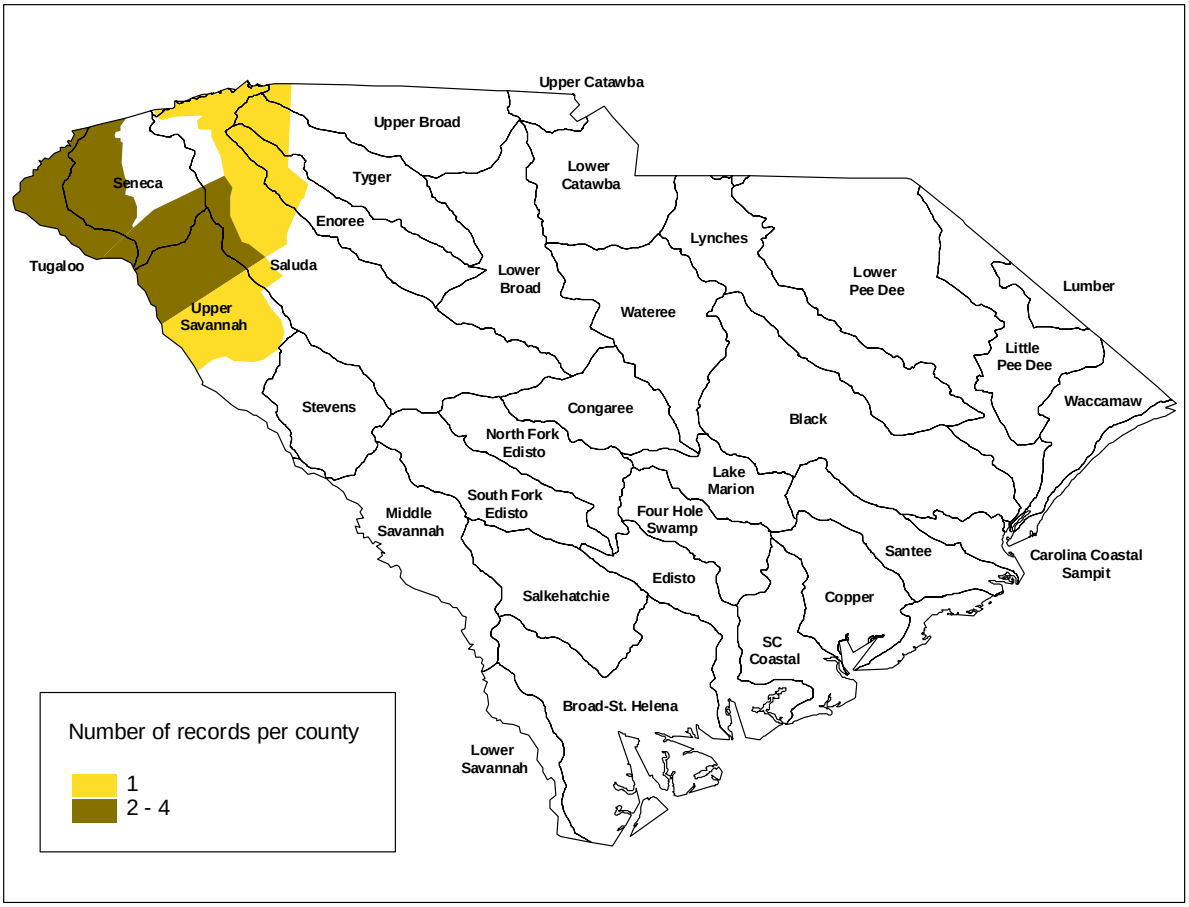

Figure 4. County based distribution of *Procambarus spiculifer* within USGS Hydrologic Cataloging Unit Boundaries. Number of records per county based on USNHM and other collection records.

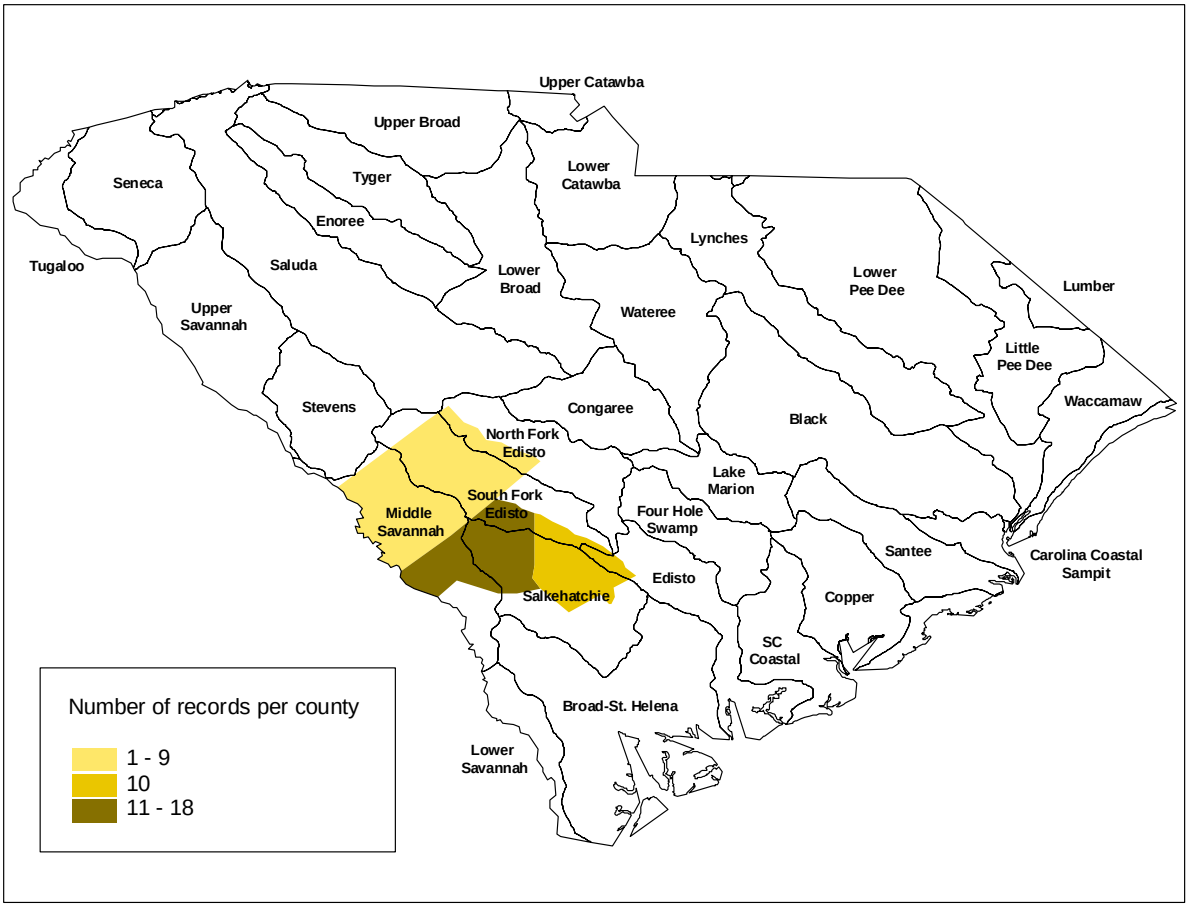

Figure 5. County based distribution of *Procambarus echinatus* within USGS Hydrologic Cataloging Unit Boundaries. Number of records per county based on USNHM and other collection records.

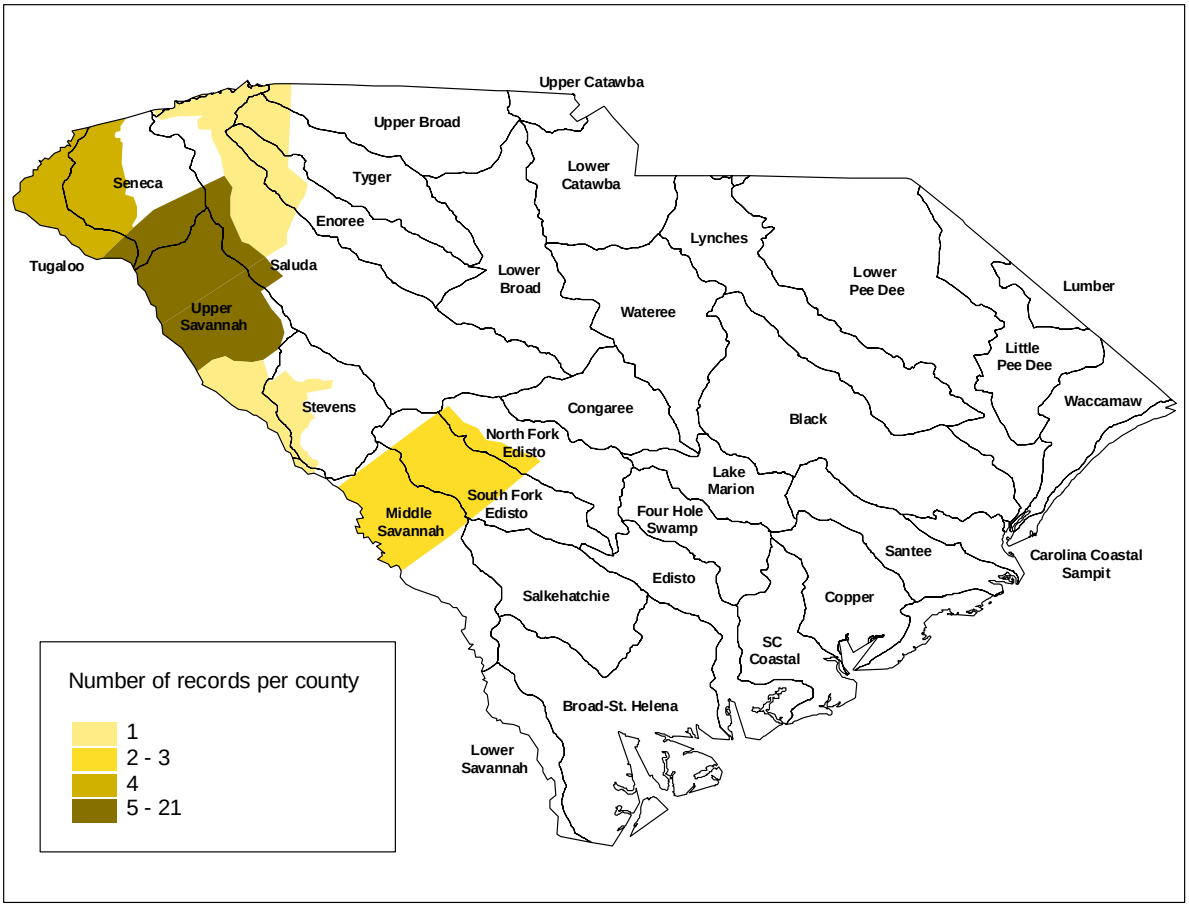

Figure 6. County based distribution of *Procambarus raneyi* within USGS Hydrologic Cataloging Unit Boundaries. Number of records per county based on USNHM and other collection records.

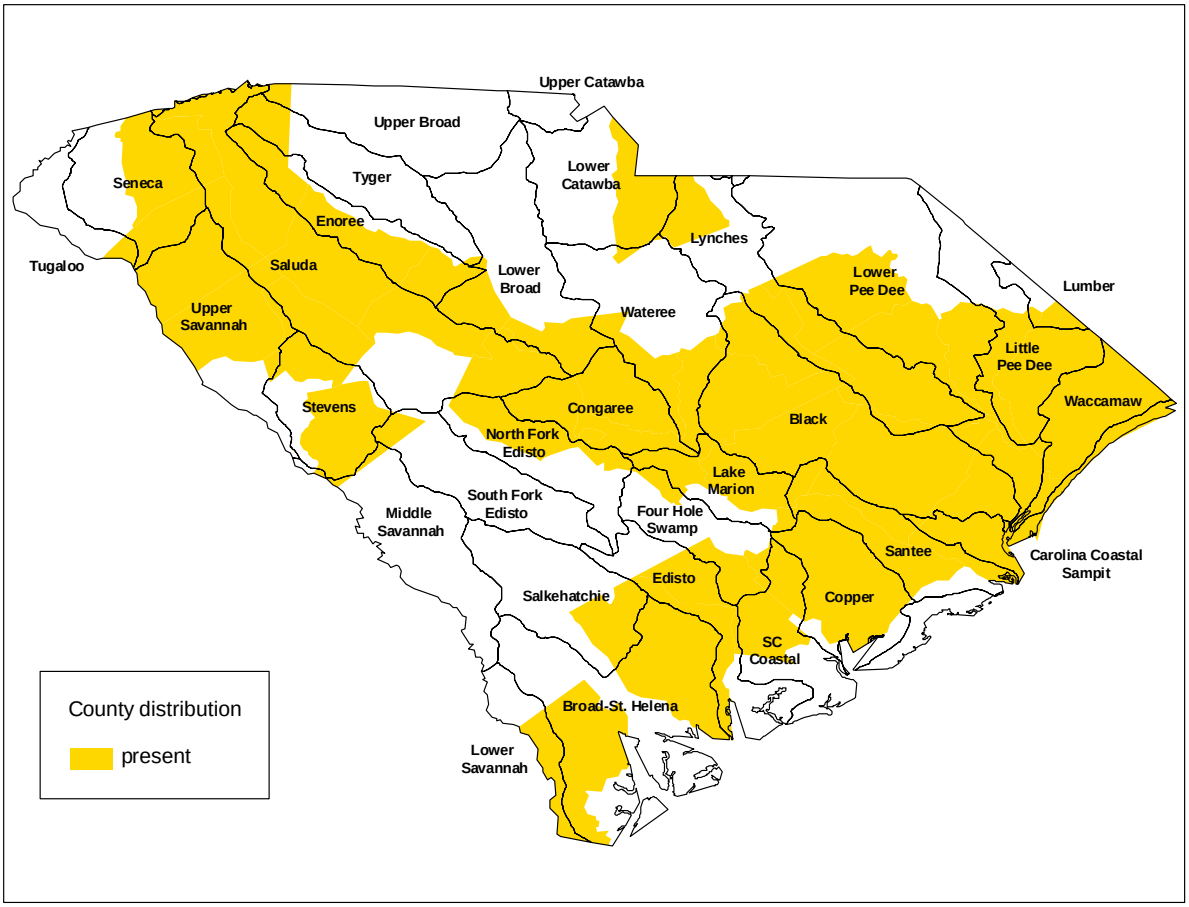

Figure 7. County based distribution of *Procambarus clarki* within USGS Hydrologic Cataloging Unit Boundaries. County distribution based on known production sites.

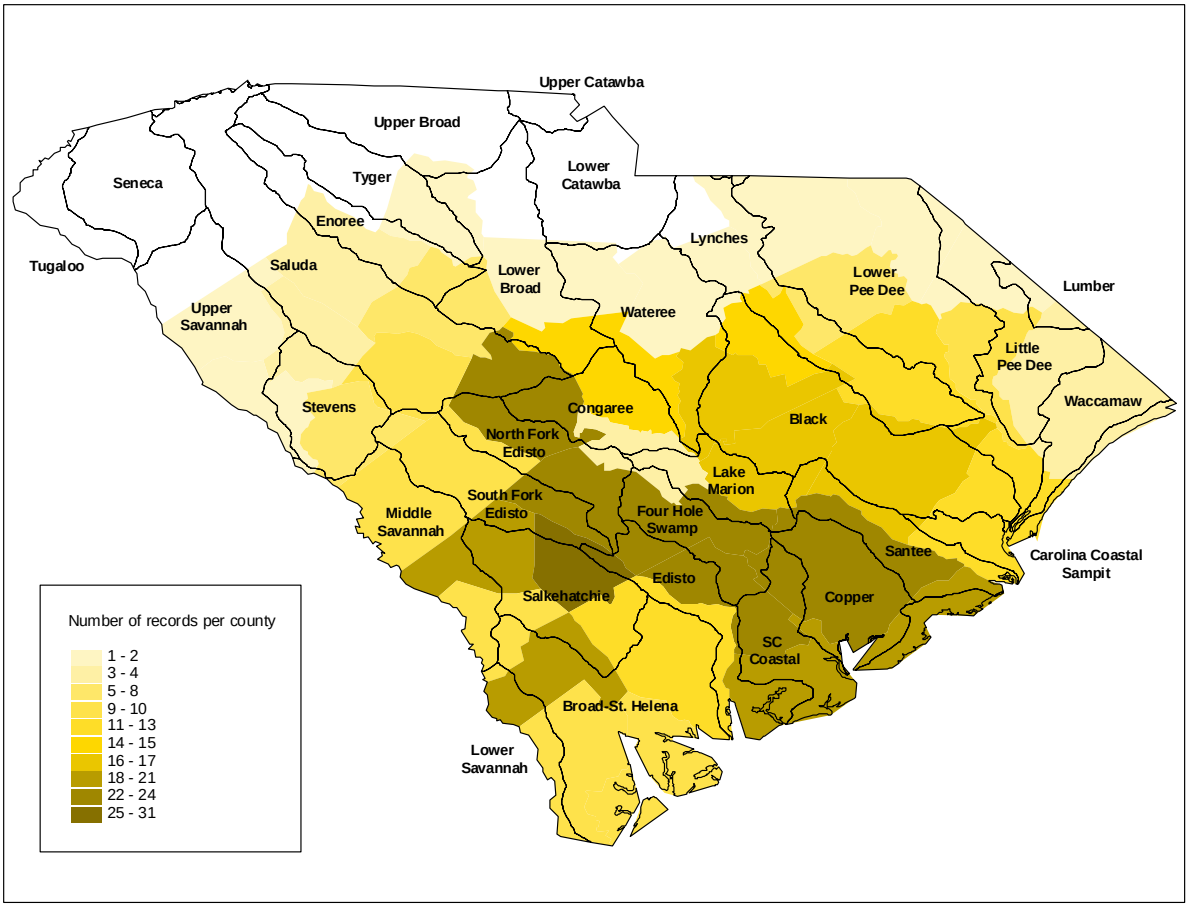

Figure 8. County based distribution of *Procambarus troglodytes* within USGS Hydrologic Cataloging Unit Boundaries. Number of records per county based on USNHM and other collection records.

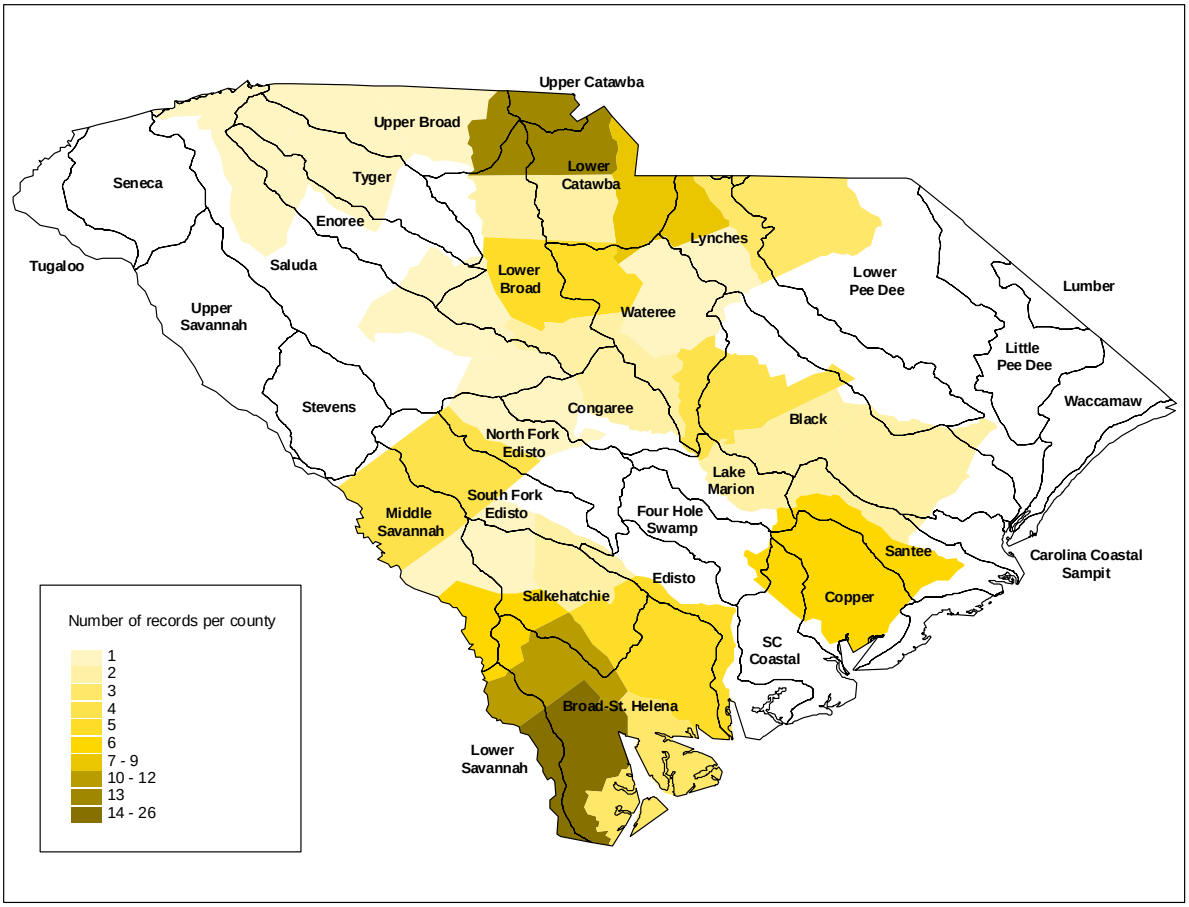

Figure 9. County based distribution of *Procambarus actus* within USGS Hydrologic Cataloging Unit Boundaries. Number of records per county based on USNHM and other collection records.

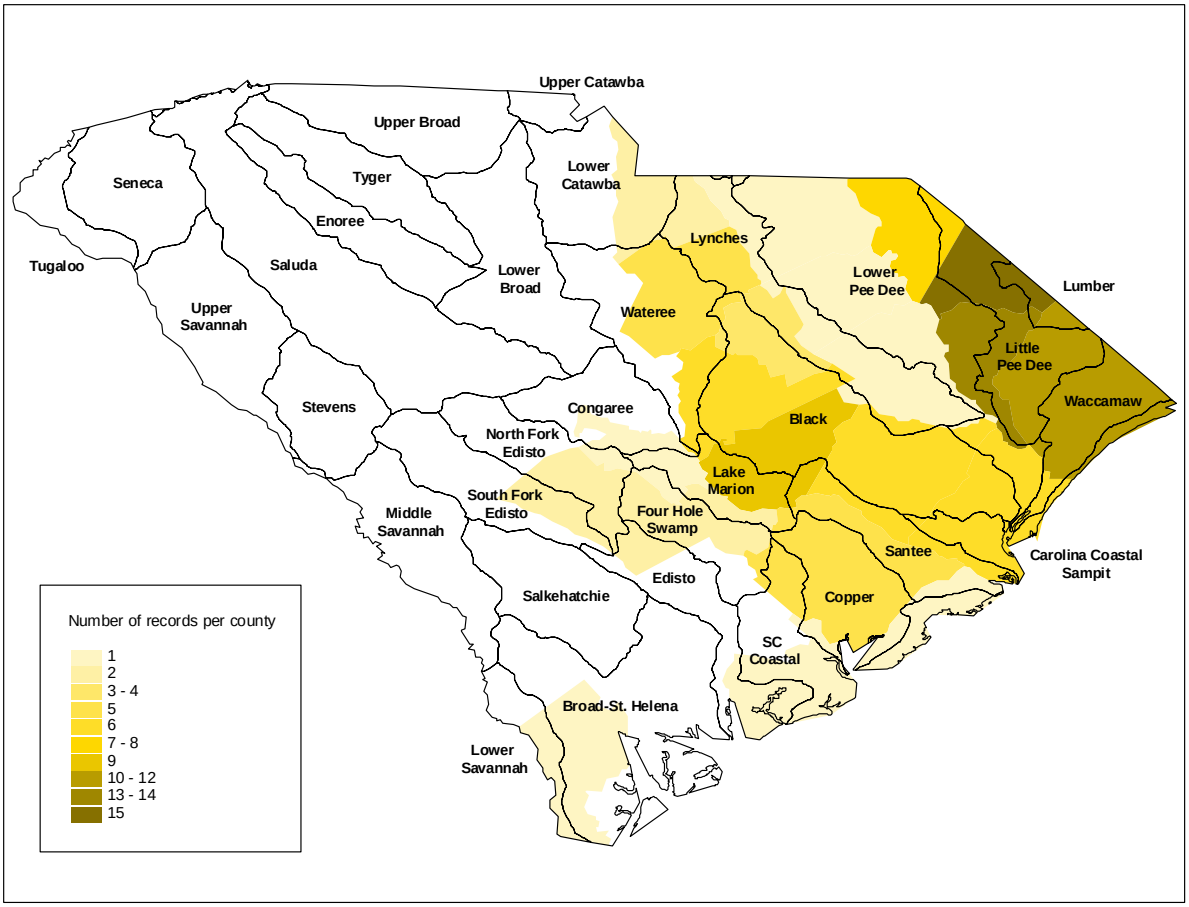

Figure 10. County based distribution of *Procambarus blandingii* within USGS Hydrologic Cataloging Unit Boundaries. Number of records per county based on USNHM and other collection records.

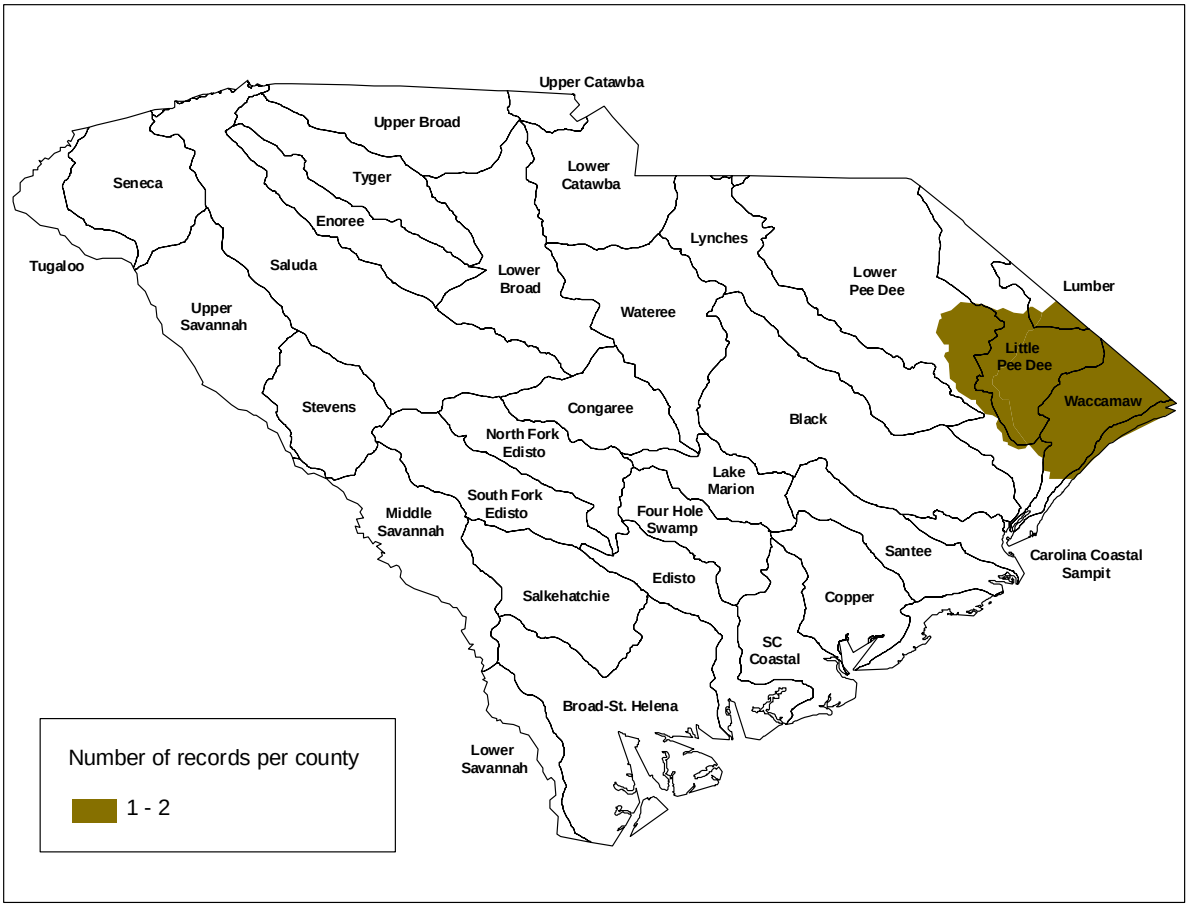

Figure 11. County based distribution of *Procambarus pearsei* within USGS Hydrologic Cataloging Unit Boundaries. Number of records per county based on USNHM and other collection records.

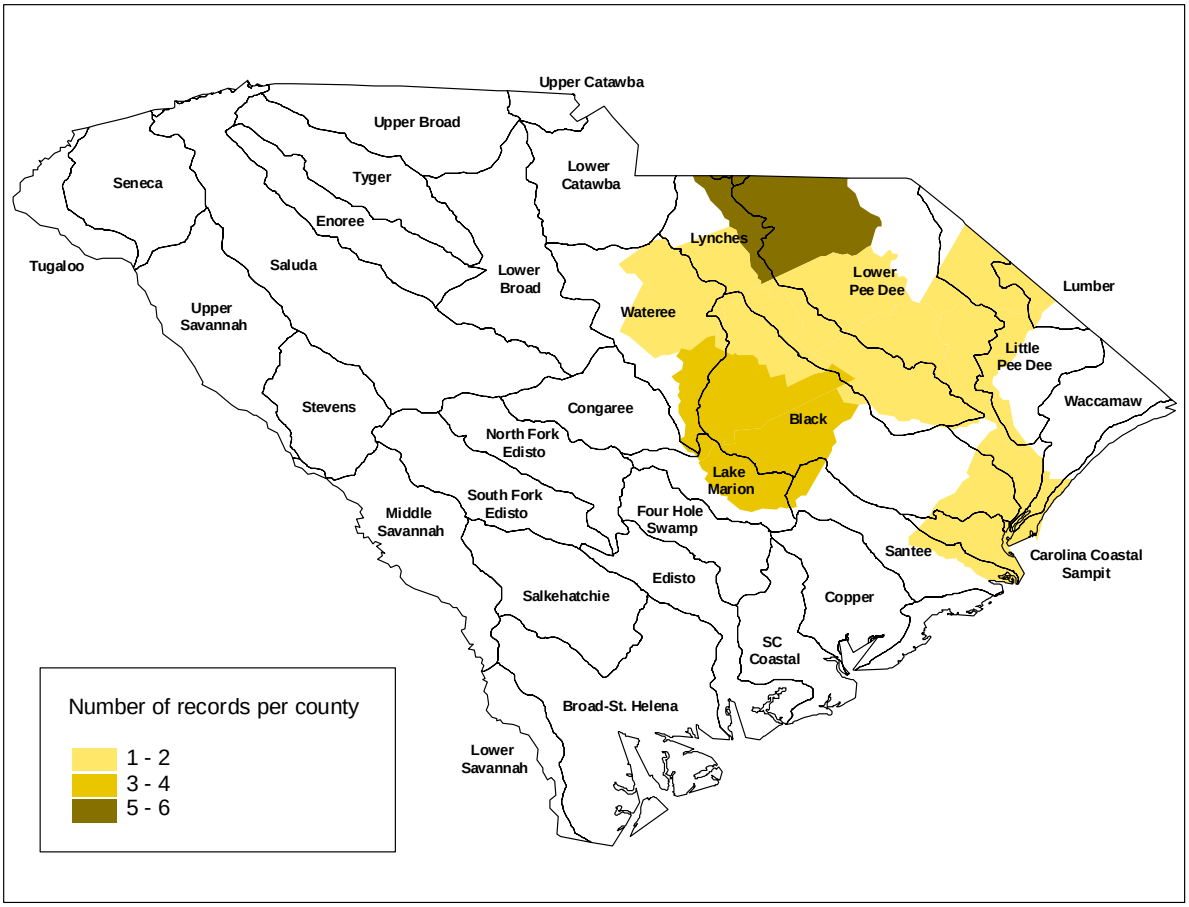

Figure 12. County based distribution of *Procambarus lepidodactylus* within USGS Hydrologic Cataloging Unit Boundaries. Number of records per county based on USNHM and other collection records.

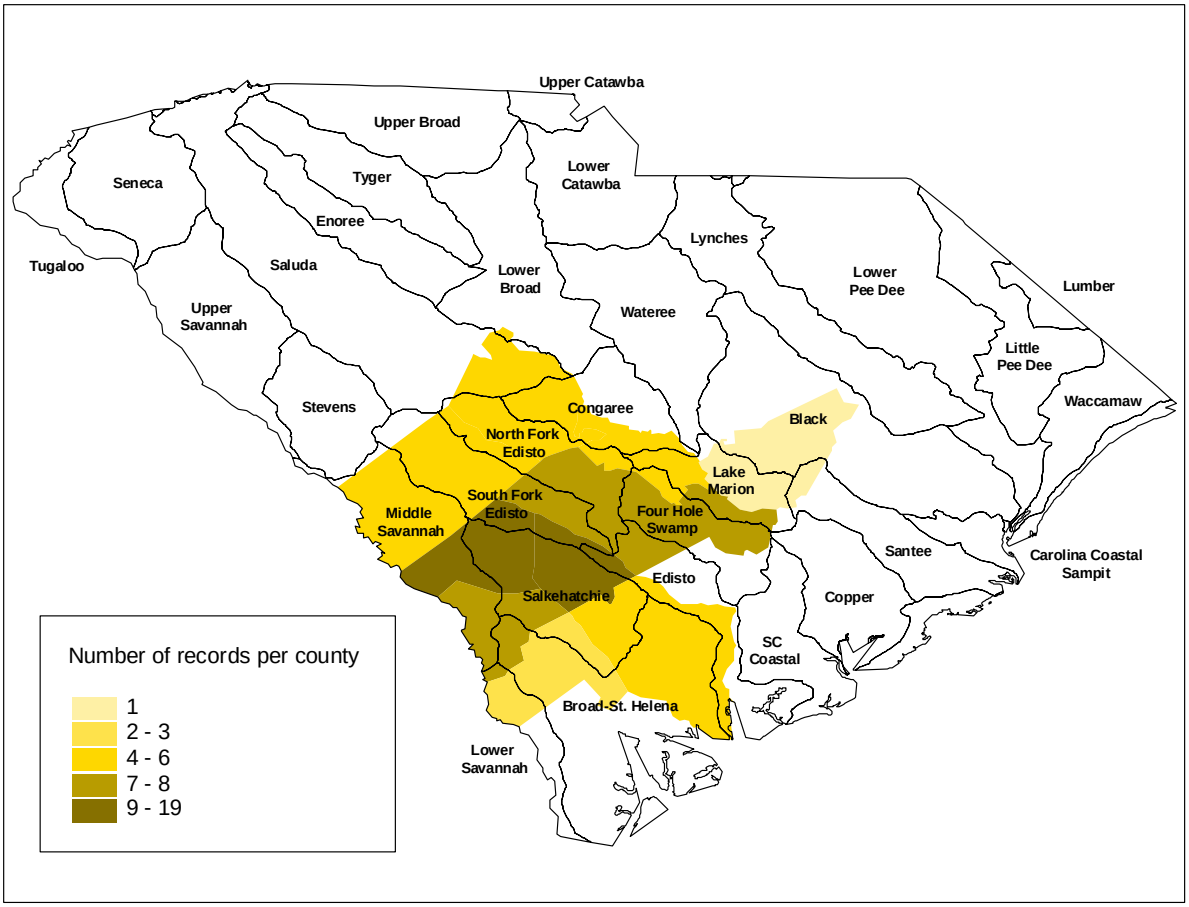

Figure 13. County based distribution of *Procambarus hirsutus* within USGS Hydrologic Cataloging Unit Boundaries. Number of records per county based on USNHM and other collection records.

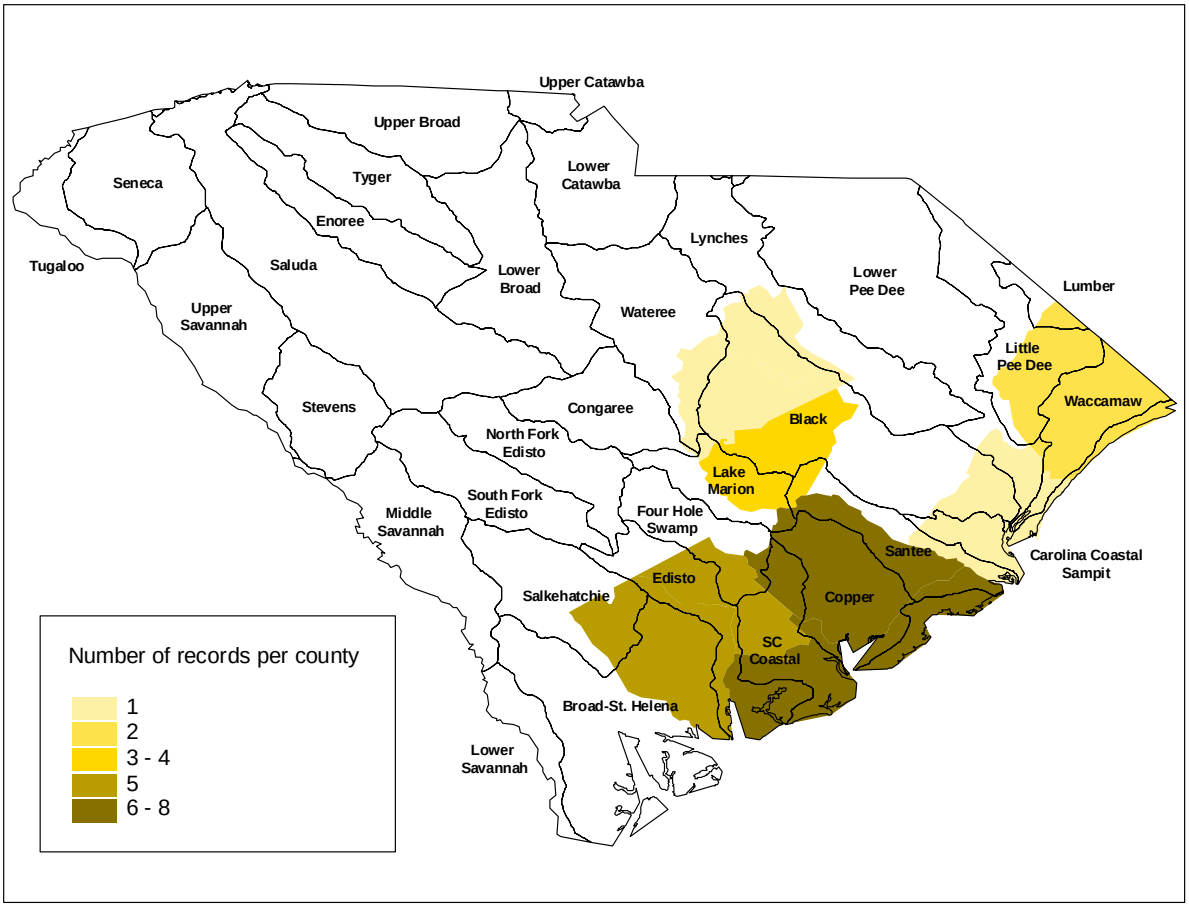

Figure 14. County based distribution of *Procambarus ancylus* within USGS Hydrologic Cataloging Unit Boundaries. Number of records per county based on USNHM and other collection records.

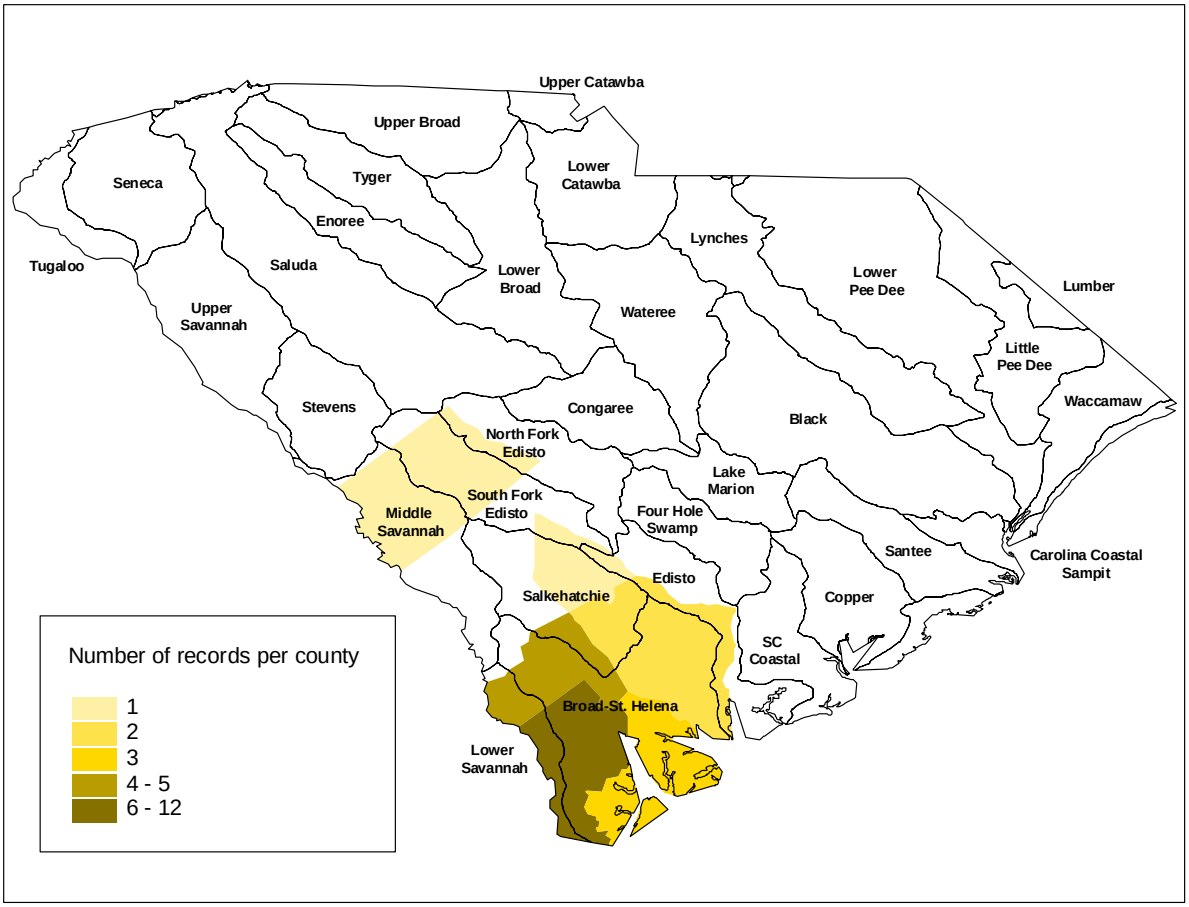

Figure 15. County based distribution of *Procambarus lunzi* within USGS Hydrologic Cataloging Unit Boundaries. Number of records per county based on USNHM and other collection records.

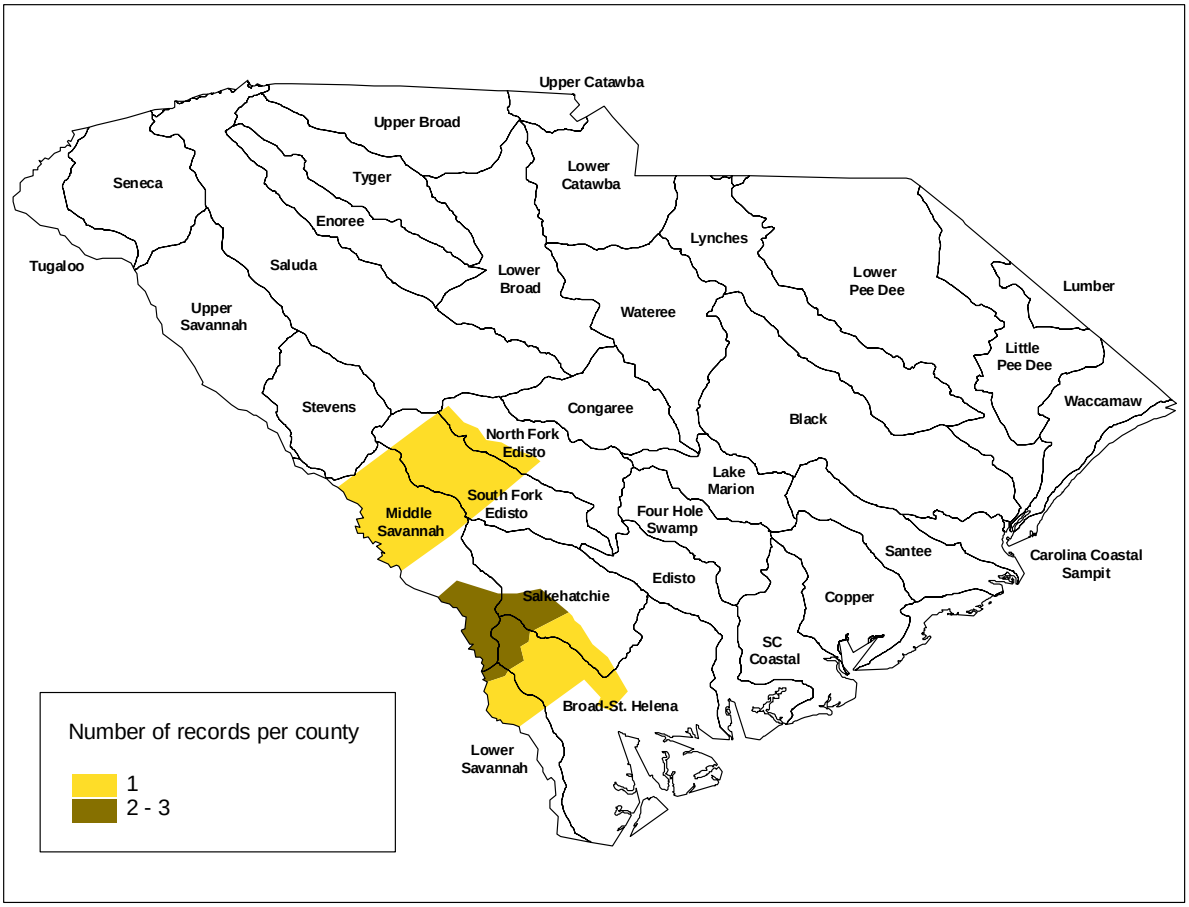

Figure 16. County based distribution of *Procambarus pubescens* within USGS Hydrologic Cataloging Unit Boundaries. Number of records per county based on USNHM and other collection records.

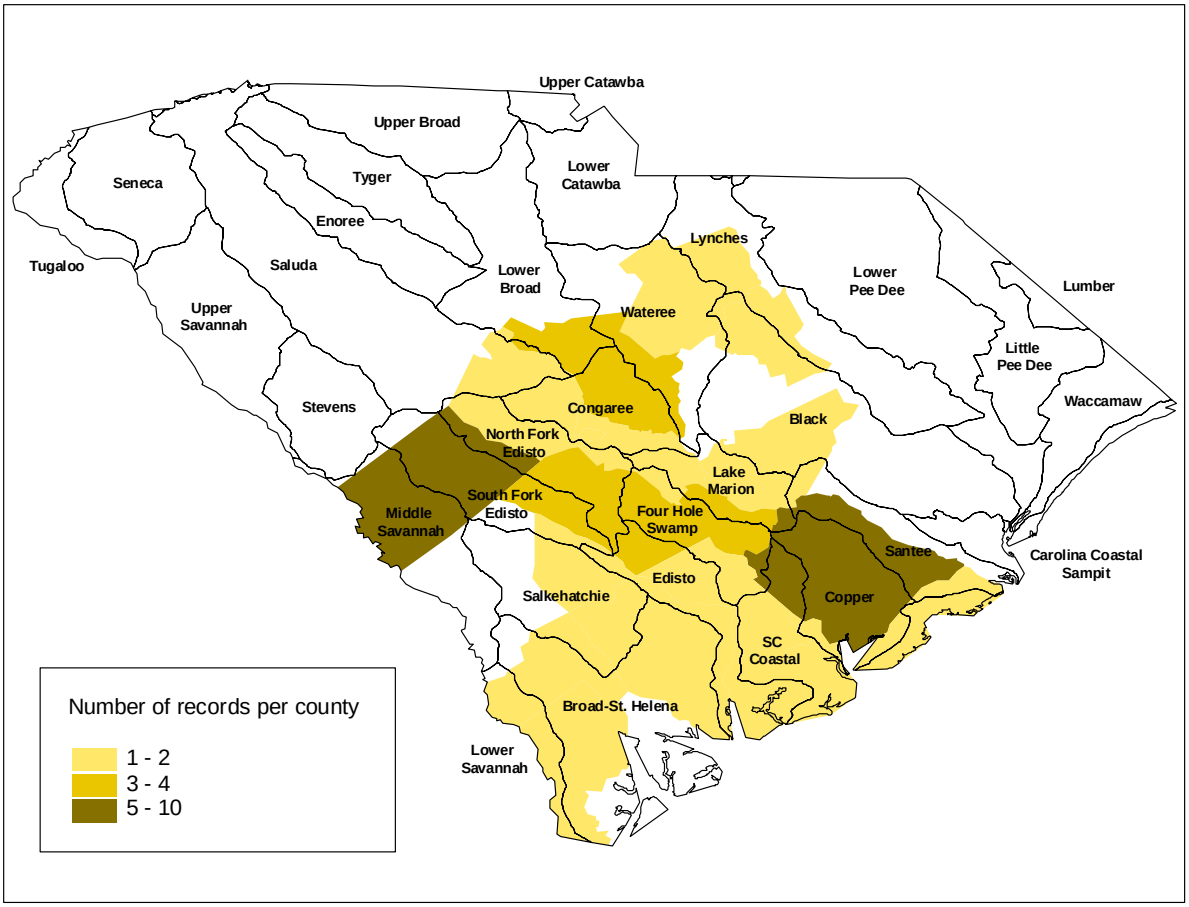

Figure 17. County based distribution of *Procambarus enoplosternum* within USGS Hydrologic Cataloging Unit Boundaries. Number of records per county based on USNHM and other collection records.

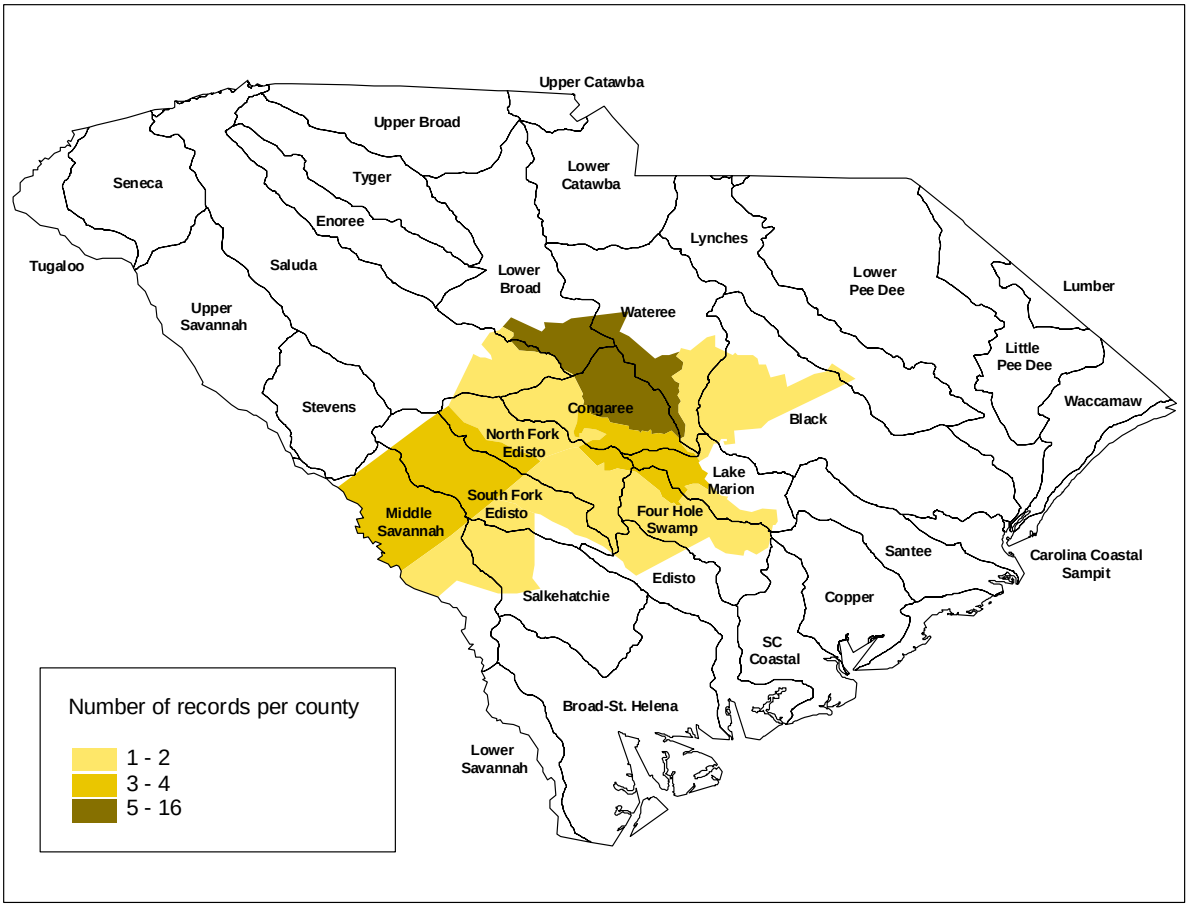

Figure 18. County based distribution of *Procambarus chacei* within USGS Hydrologic Cataloging Unit Boundaries. Number of records per county based on USNHM and other collection records.

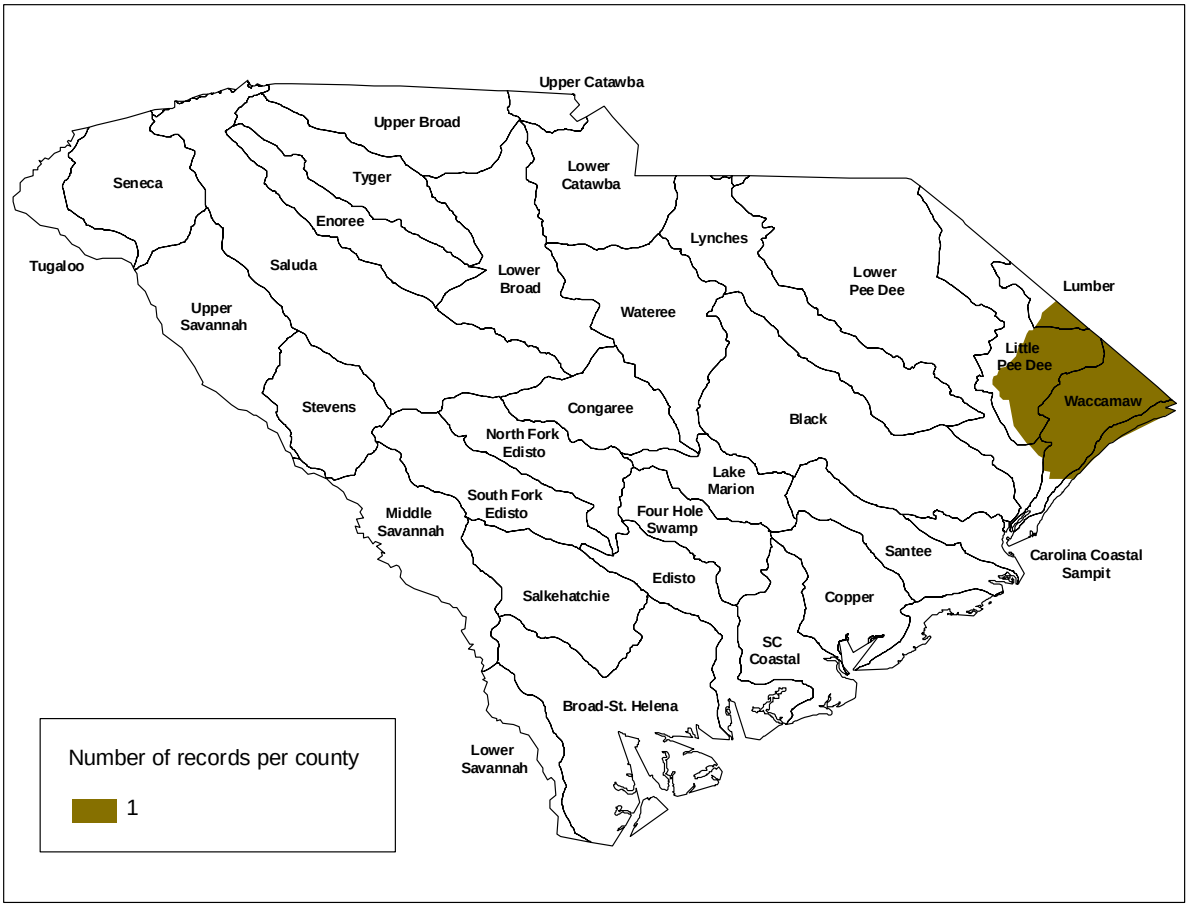

Figure 19. County based distribution of *Procambarus braswelli* within USGS Hydrologic Cataloging Unit Boundaries. Number of records per county based on USNHM and other collection records.

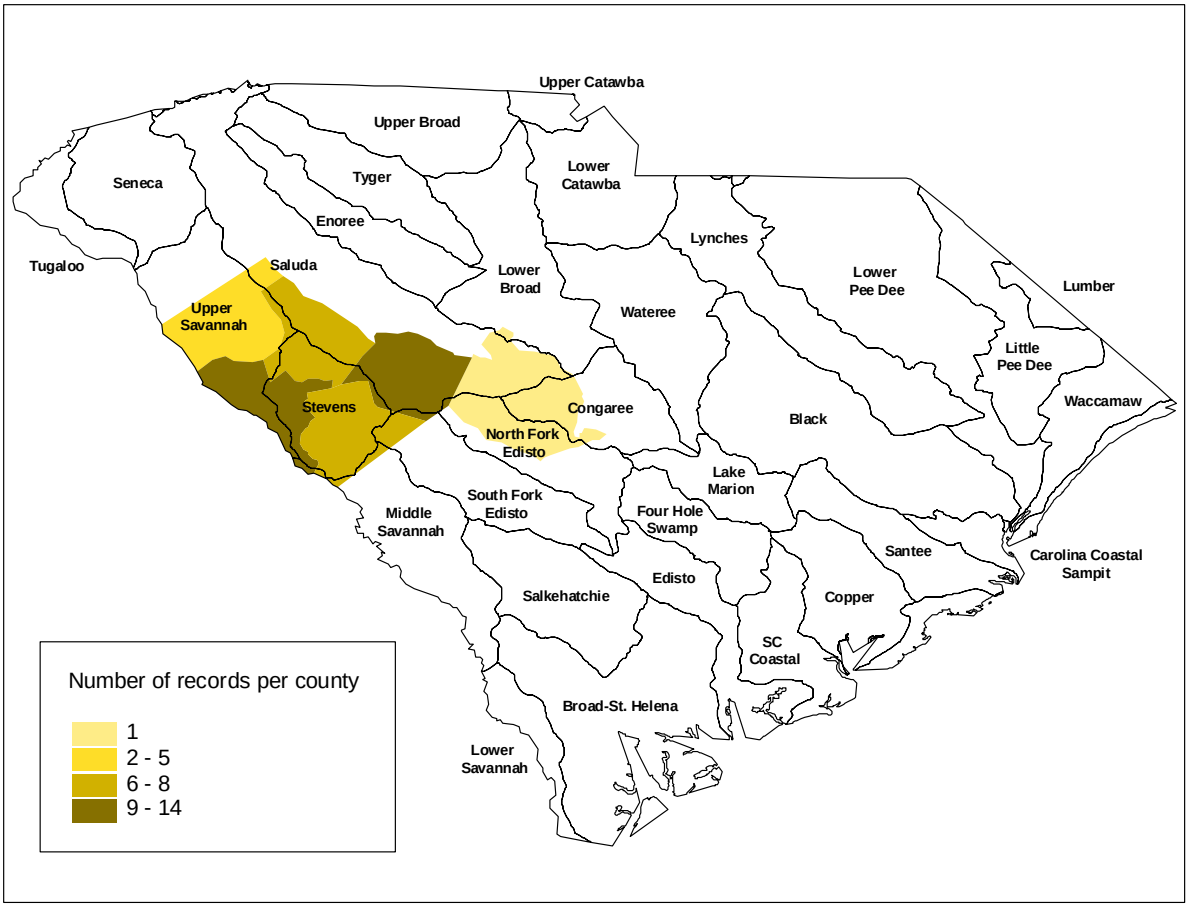

Figure 20. County based distribution of *Distocambarus crockeri* within USGS Hydrologic Cataloging Unit Boundaries. Number of records per county based on USNHM and other collection records.

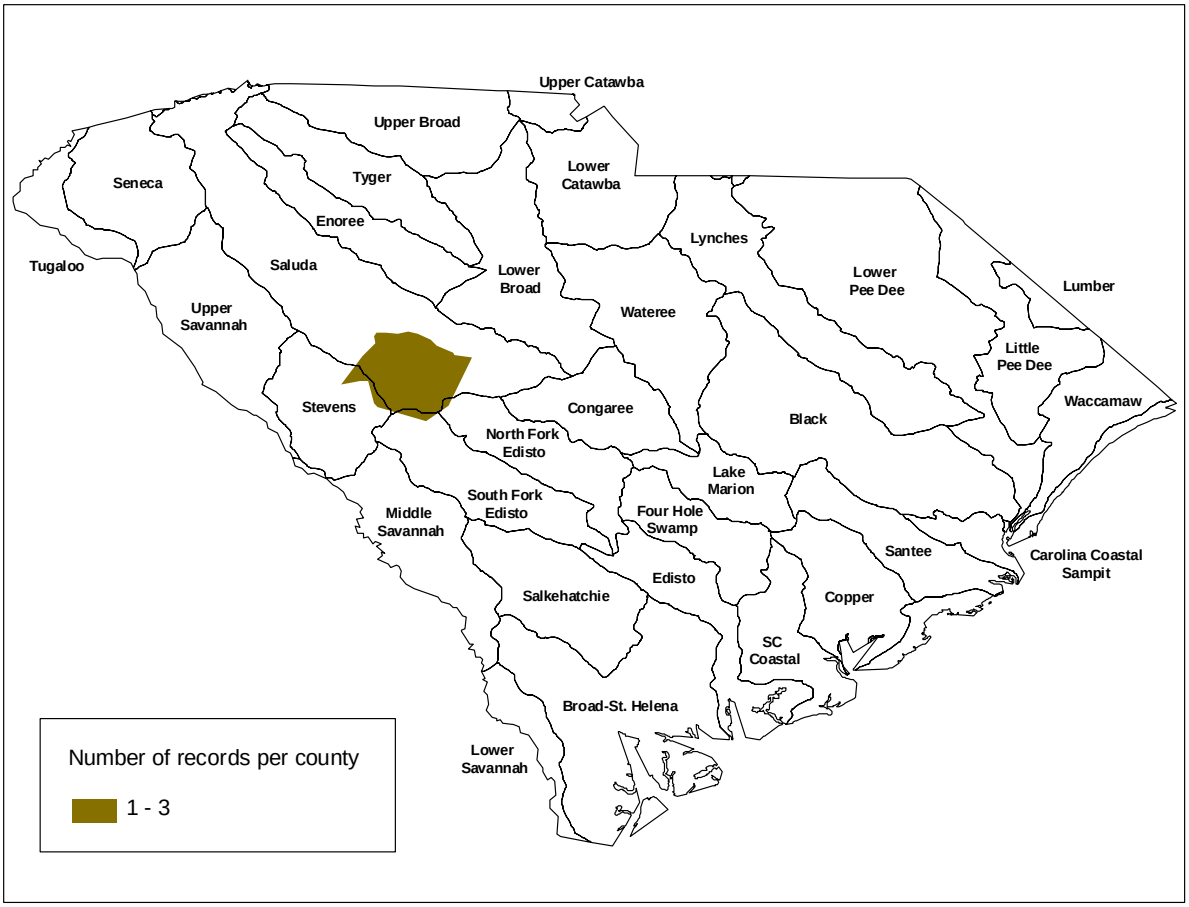

Figure 21. County based distribution of *Distocambarus hunteri* within USGS Hydrologic Cataloging Unit Boundaries. Number of records per county based on USNHM and other collection records.

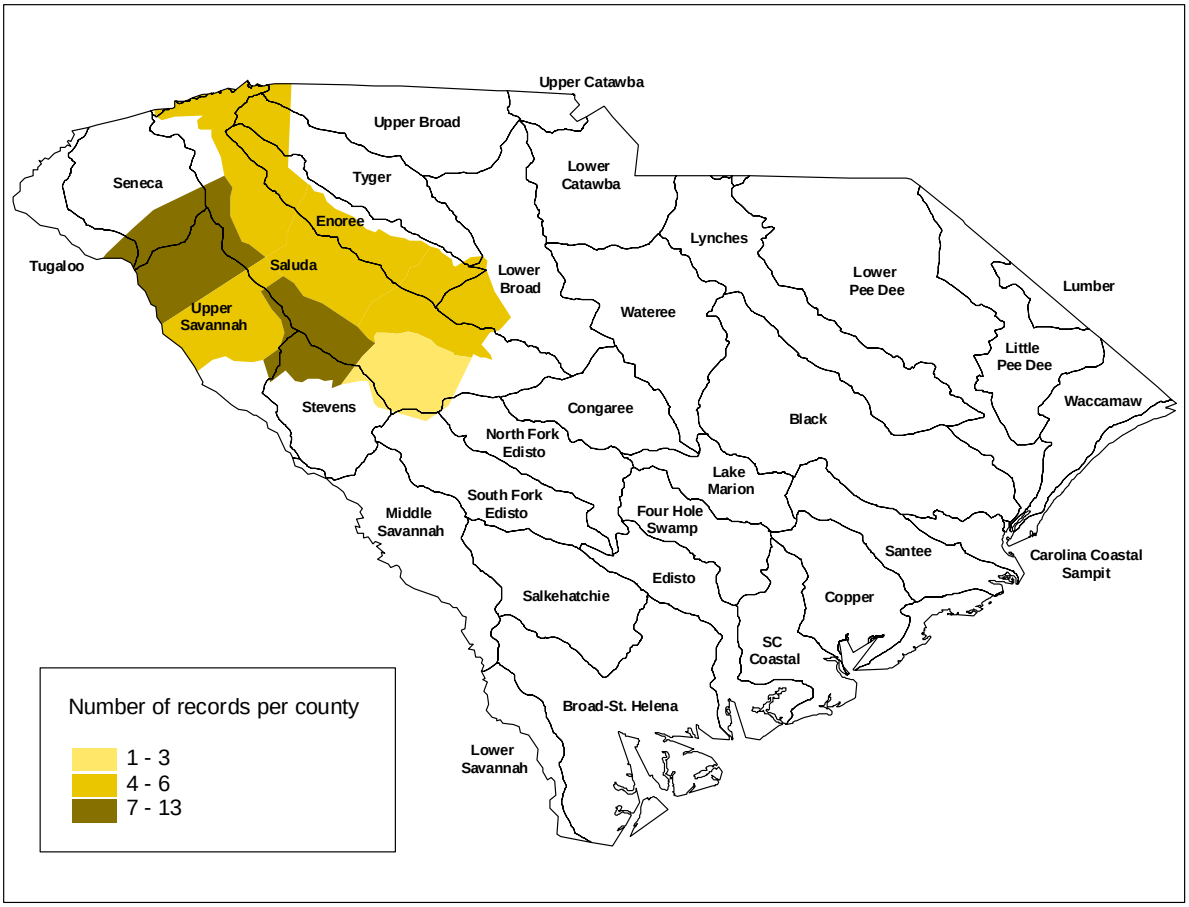

Figure 22. County based distribution of *Distocambarus carlsoni* within USGS Hydrologic Cataloging Unit Boundaries. Number of records per county based on USNHM and other collection records.

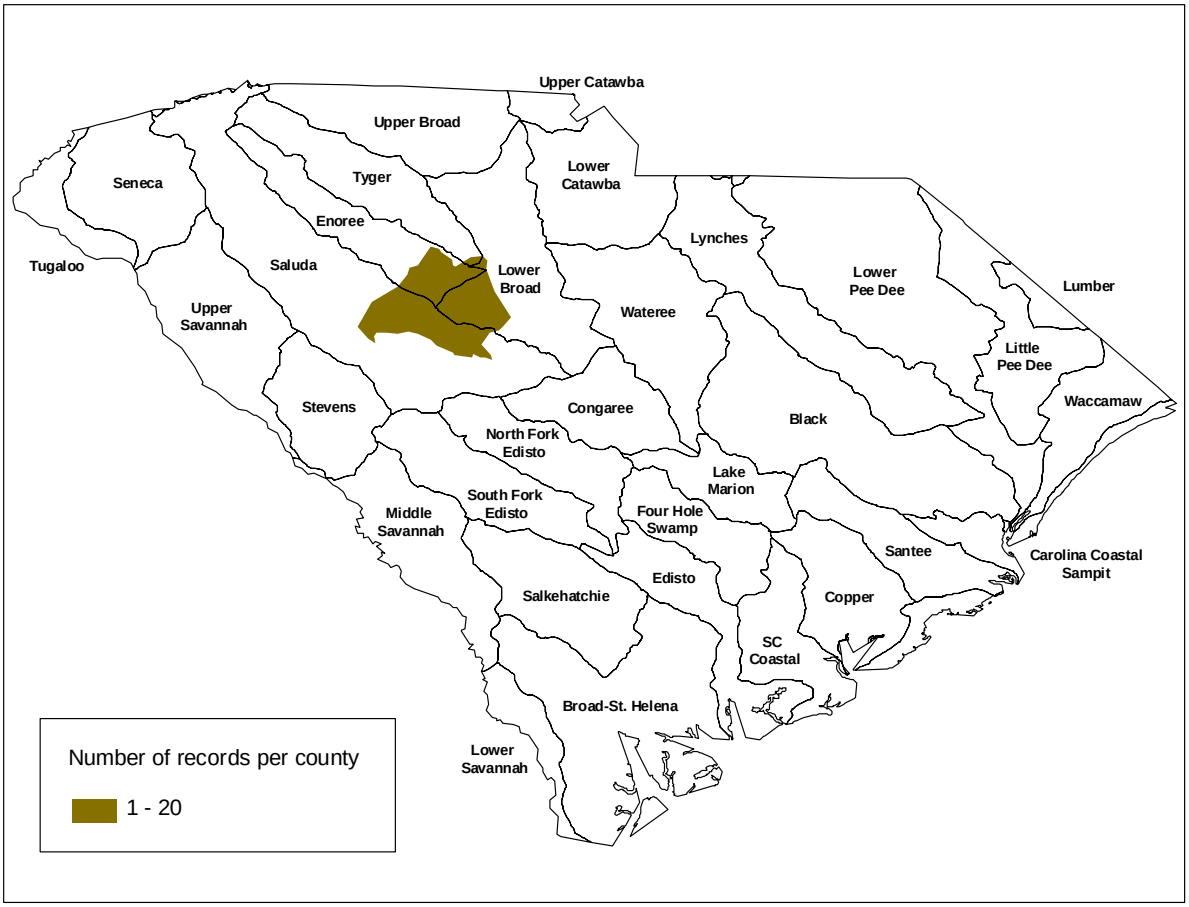

Figure 23. County based distribution of *Distocambarus youngineri* within USGS Hydrologic Cataloging Unit Boundaries. Number of records per county based on USNHM and other collection records.

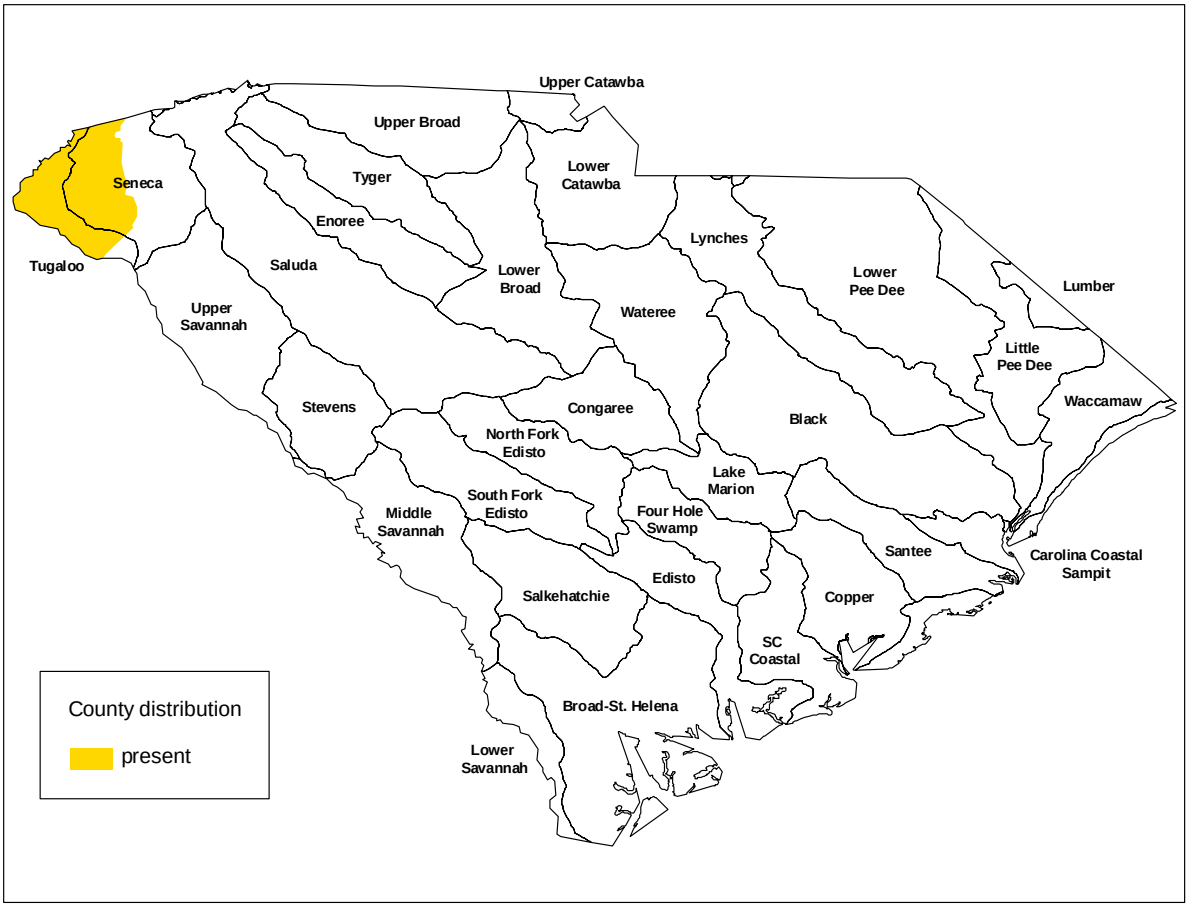

Figure 24. County based distribution of *Cambarus sp nov* within USGS Hydrologic Cataloging Unit Boundaries.

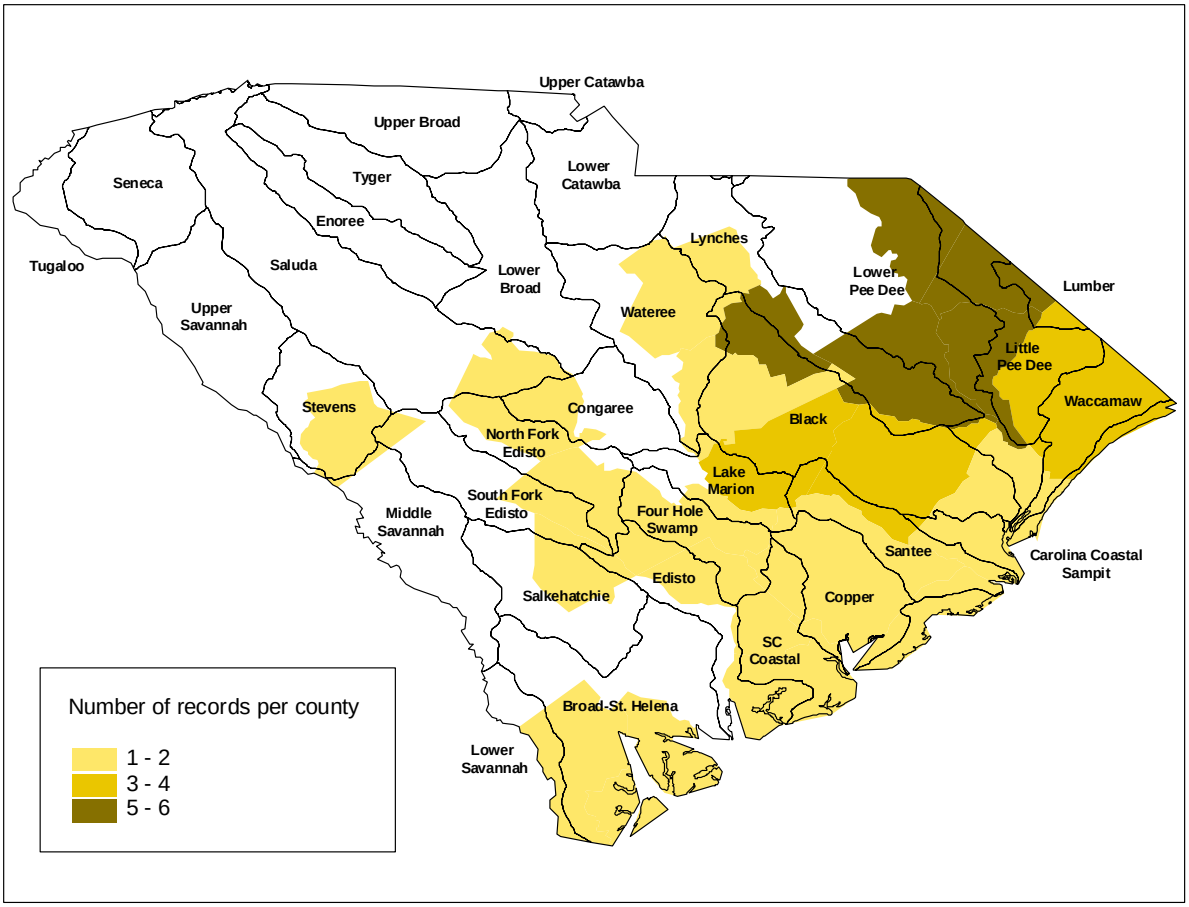

Figure 25. County based distribution of *Cambarus diogenes* within USGS Hydrologic Cataloging Unit Boundaries. Number of records per county based on USNHM and other collection records.

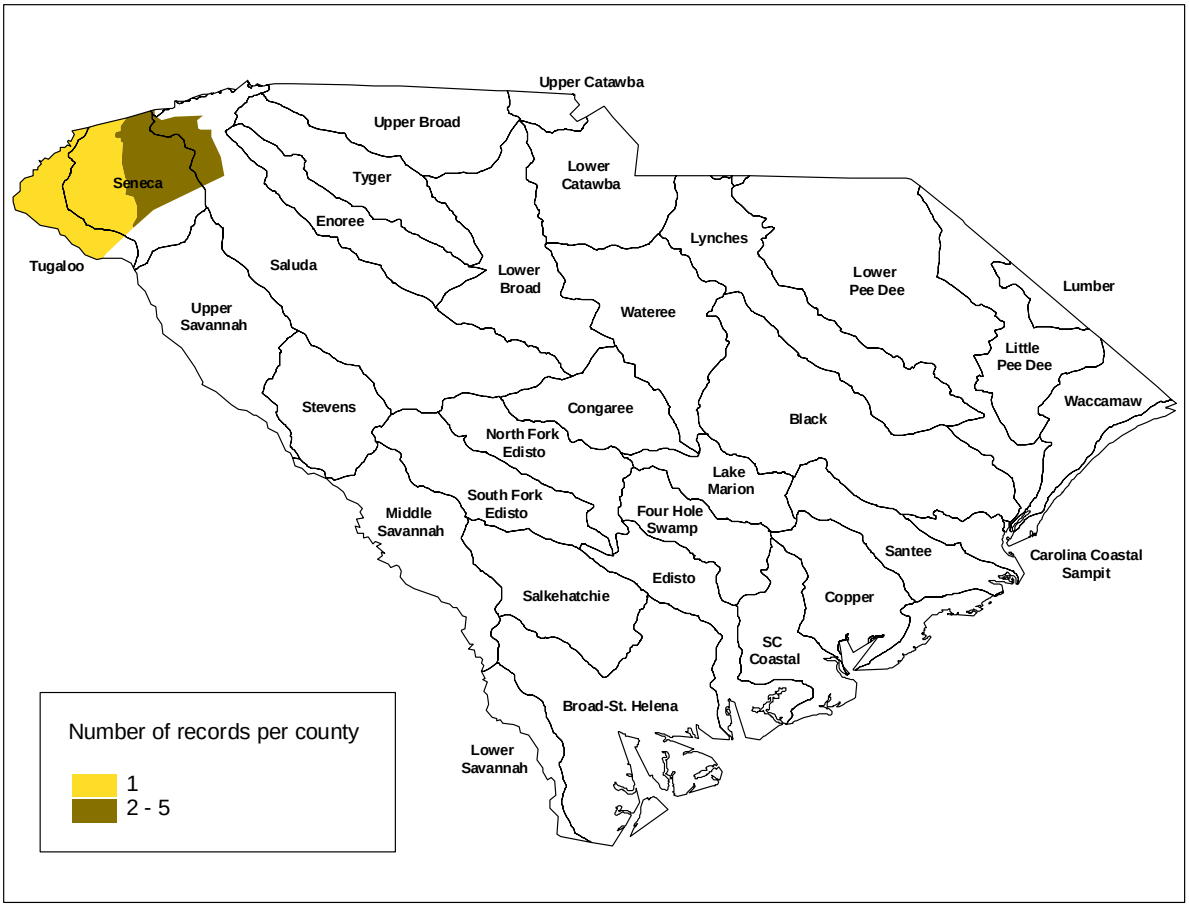

Figure 26. County based distribution of *Cambarus nodosus* within USGS Hydrologic Cataloging Unit Boundaries. Number of records per county based on USNHM and other collection records.

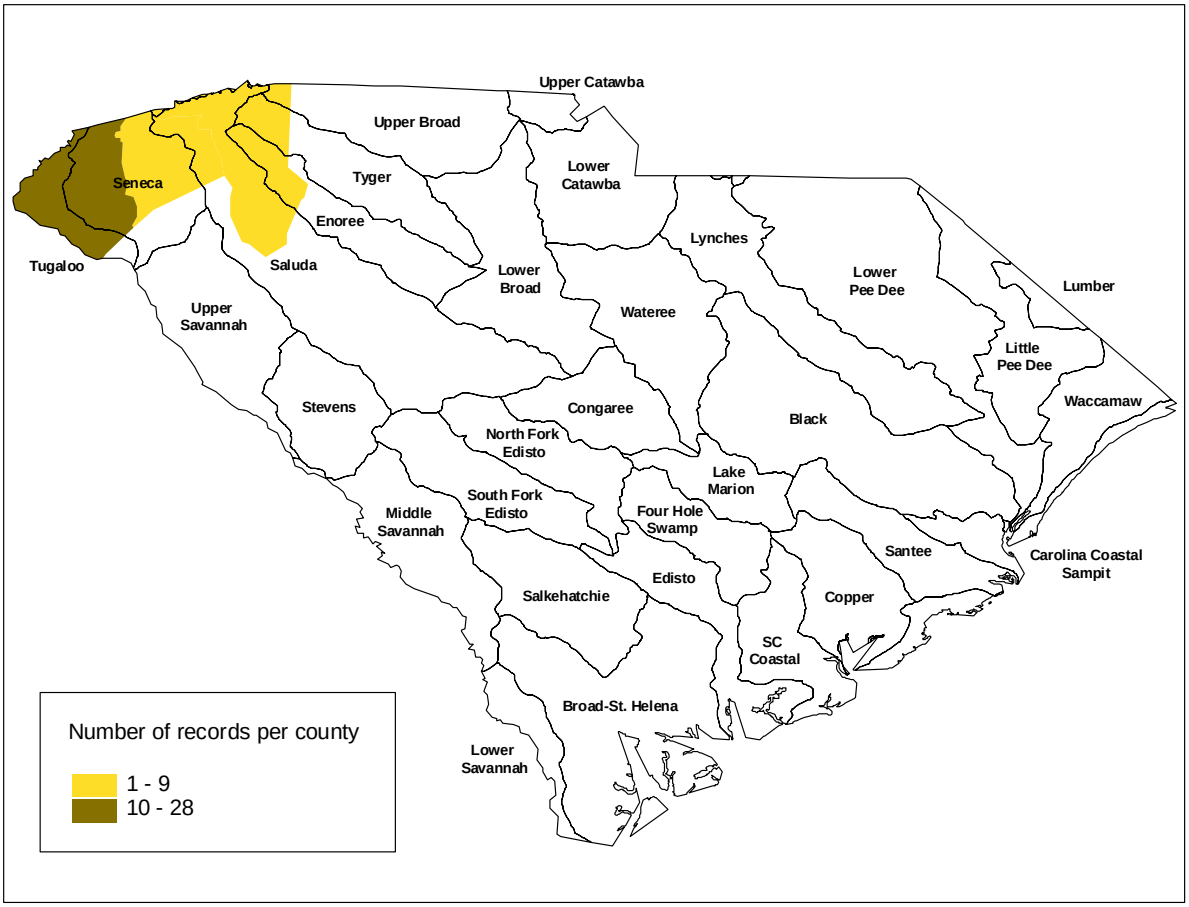

Figure 27. County based distribution of *Cambarus asperimanus* within USGS Hydrologic Cataloging Unit Boundaries. Number of records per county based on USNHM and other collection records.

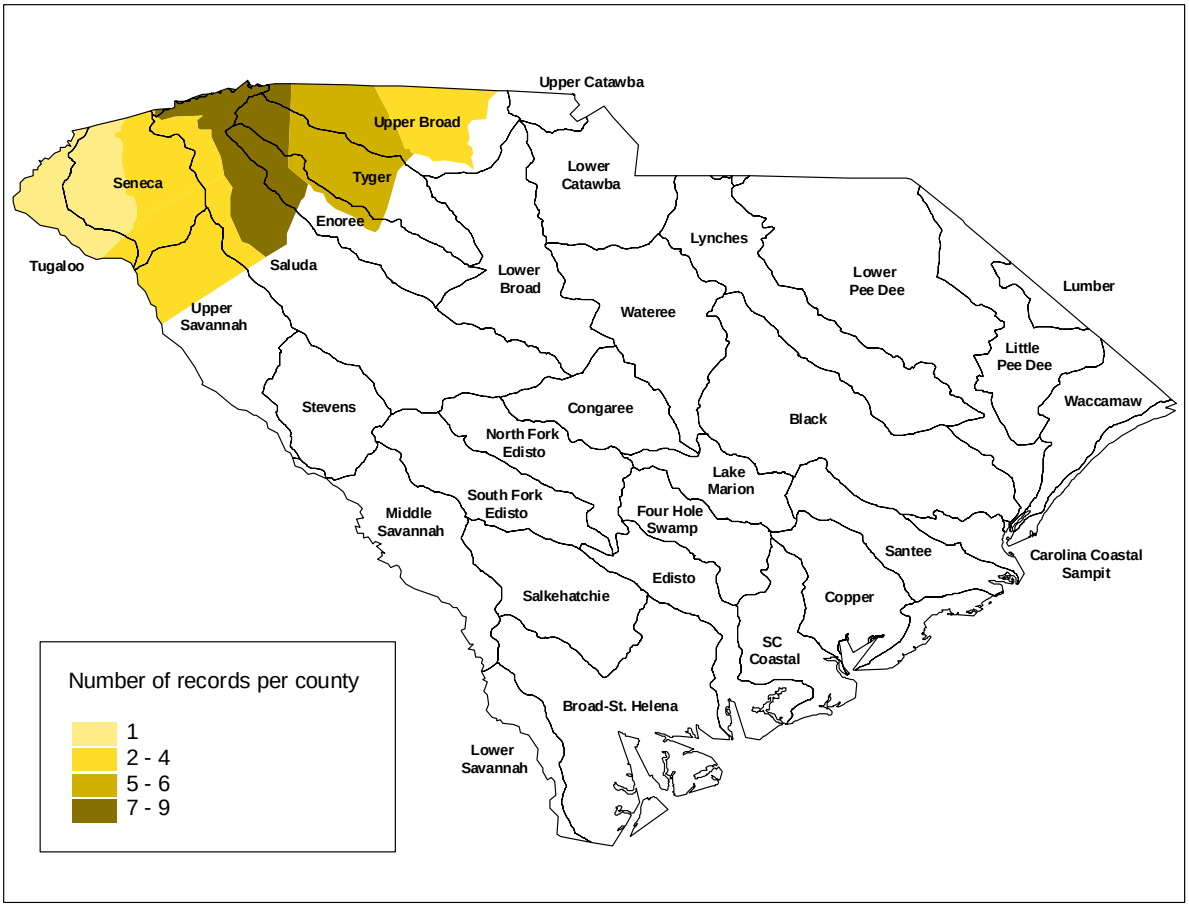

Figure 28. County based distribution of *Cambarus carolinus* within USGS Hydrologic Cataloging Unit Boundaries. Number of records per county based on USNHM and other collection records.

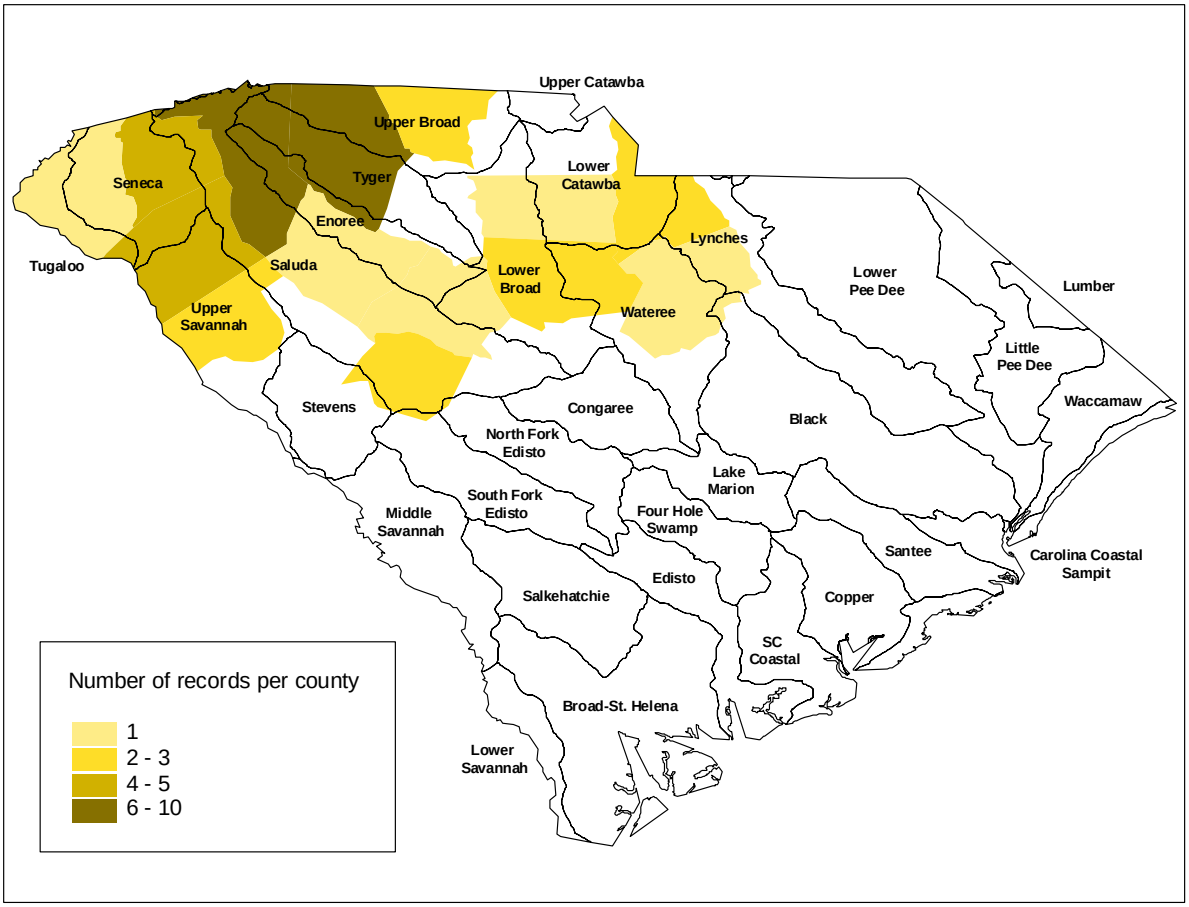

Figure 29. County based distribution of *Cambarus howardi* within USGS Hydrologic Cataloging Unit Boundaries. Number of records per county based on USNHM and other collection records.

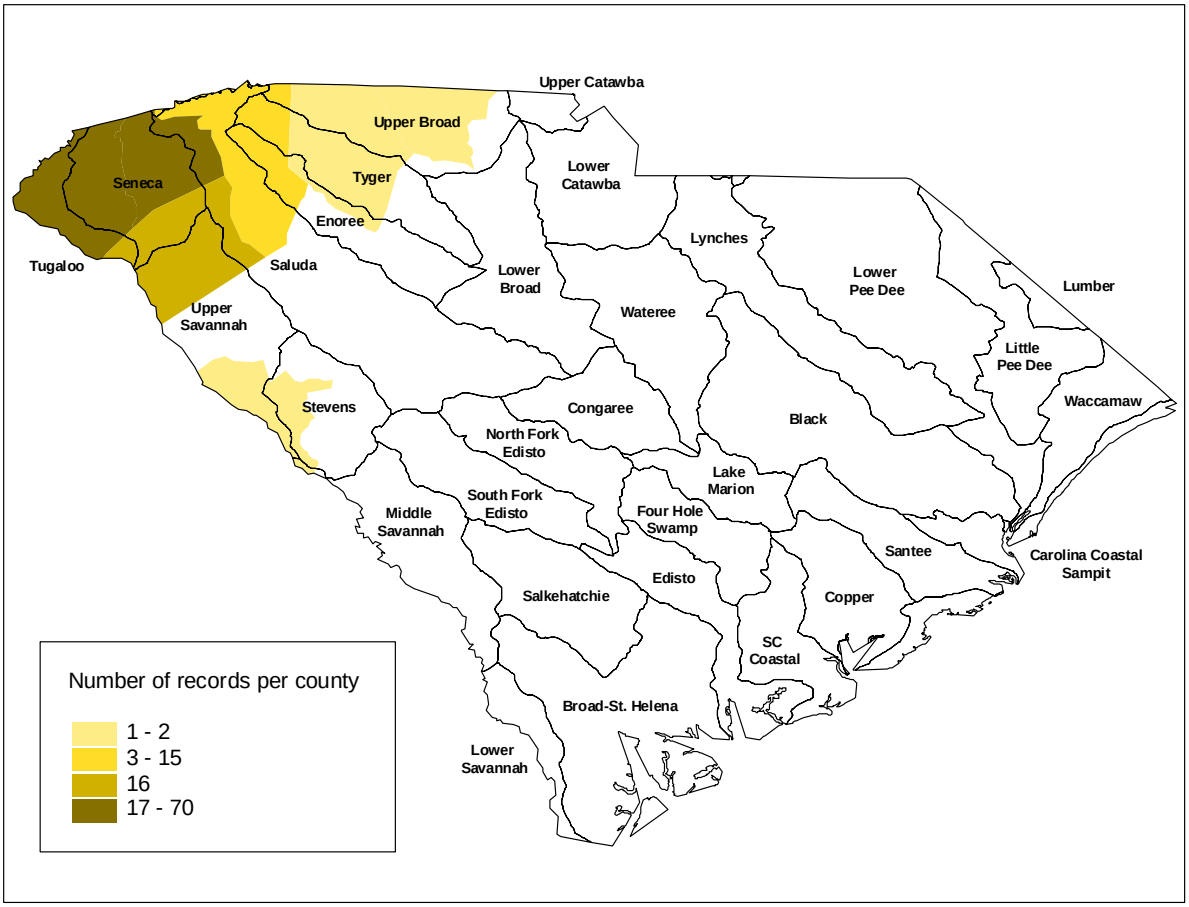

Figure 30. County based distribution of *Cambarus bartonii* within USGS Hydrologic Cataloging Unit Boundaries. Number of records per county based on USNHM and other collection records.

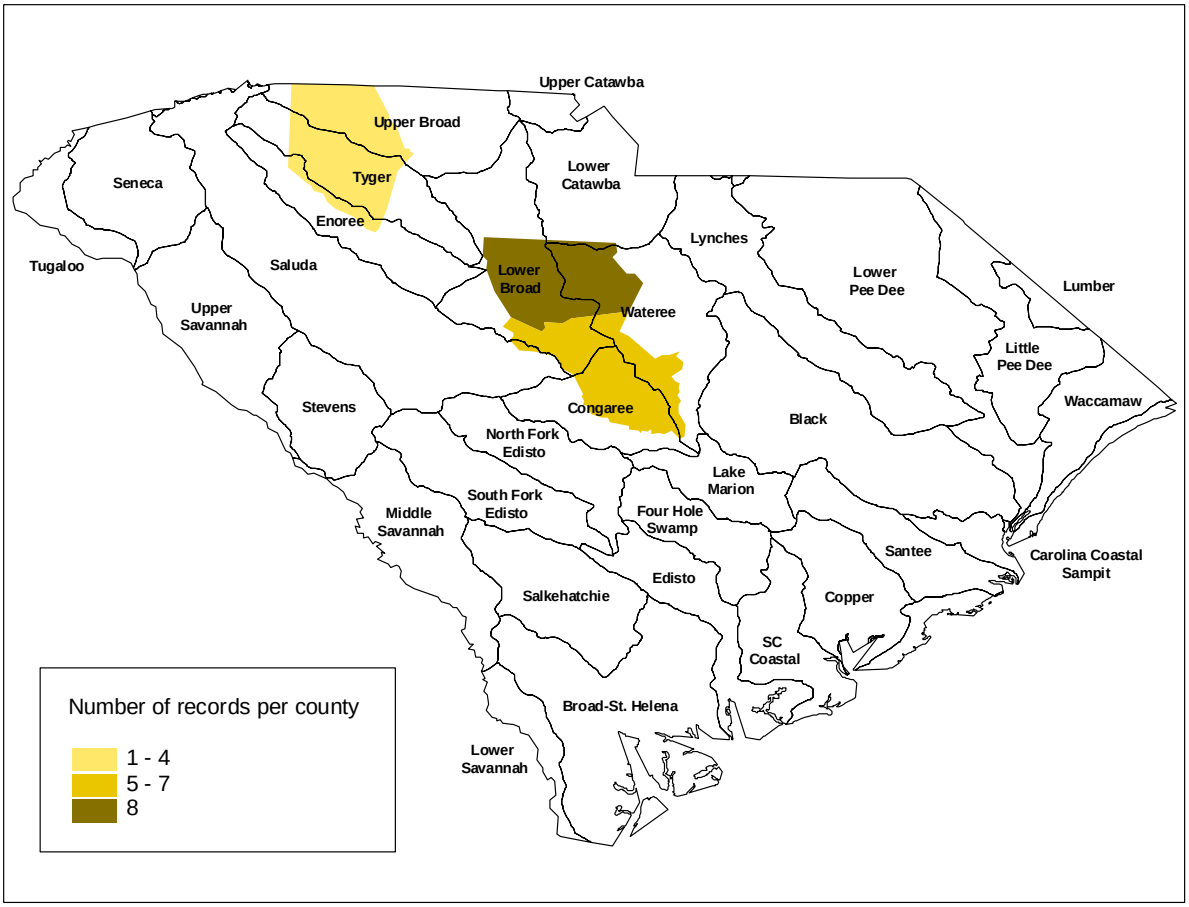

Figure 31. County based distribution of *Cambarus spicatus* within USGS Hydrologic Cataloging Unit Boundaries. Number of records per county based on USNHM and other collection records.

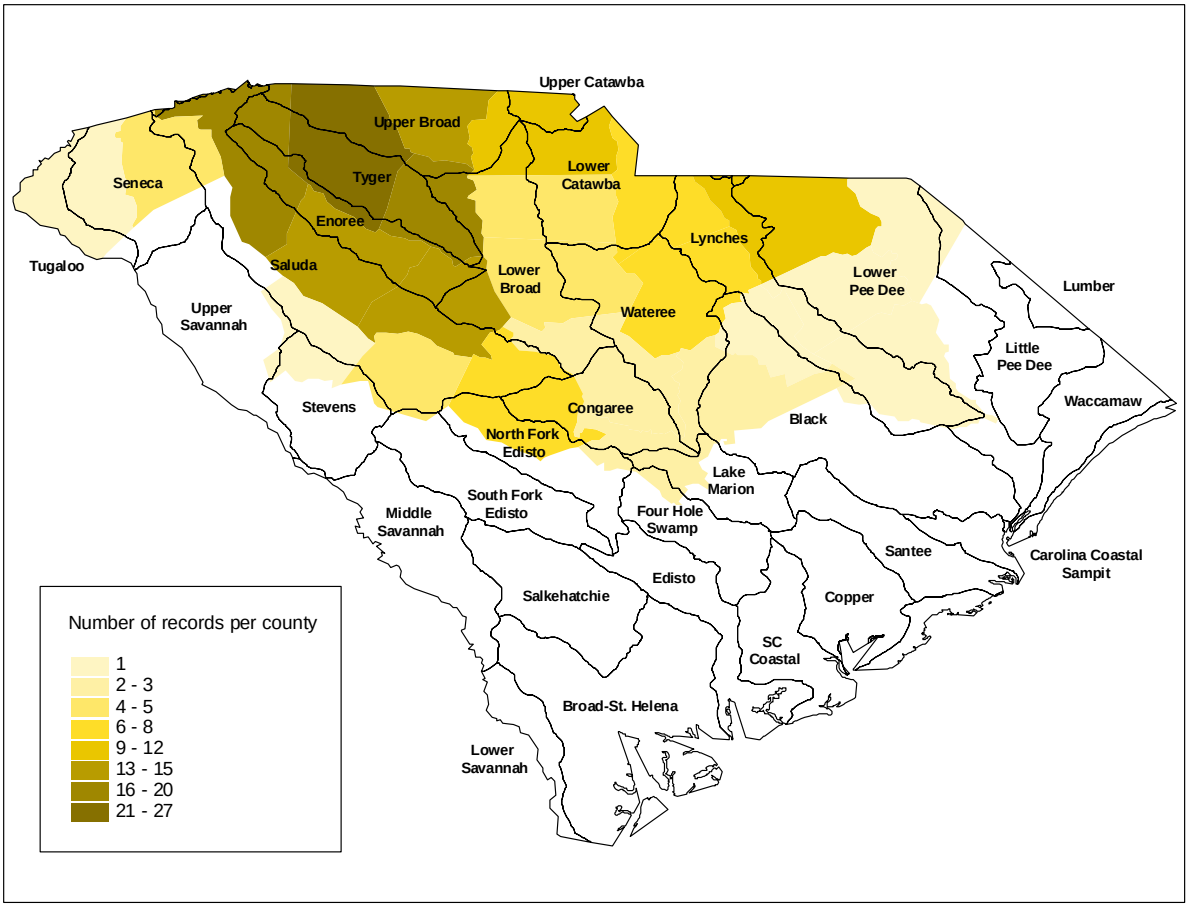

Figure 32. County based distribution of *Cambarus acuminatus* within USGS Hydrologic Cataloging Unit Boundaries. Number of records per county based on USNHM and other collection records.

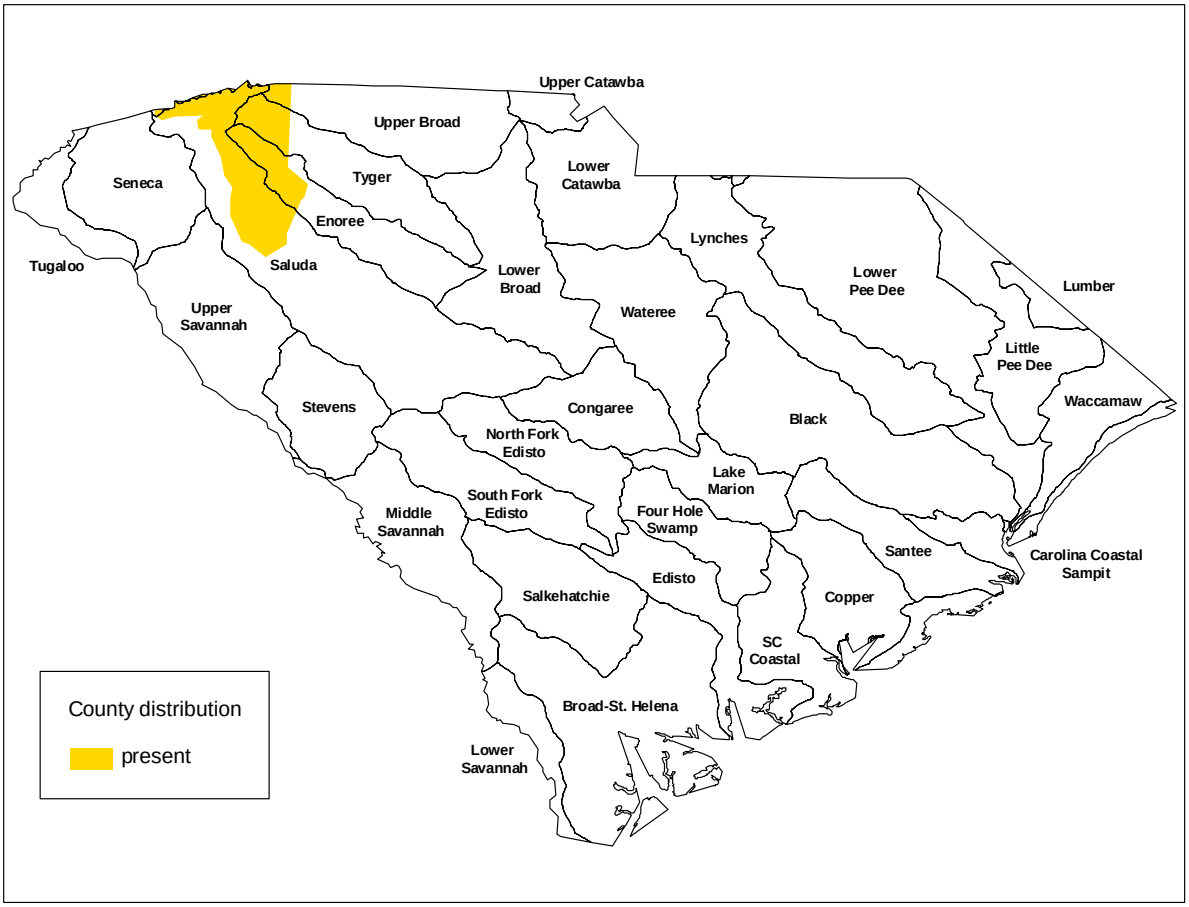

Figure 33. County based distribution of *Cambarus robustus* within USGS Hydrologic Cataloging Unit Boundaries.

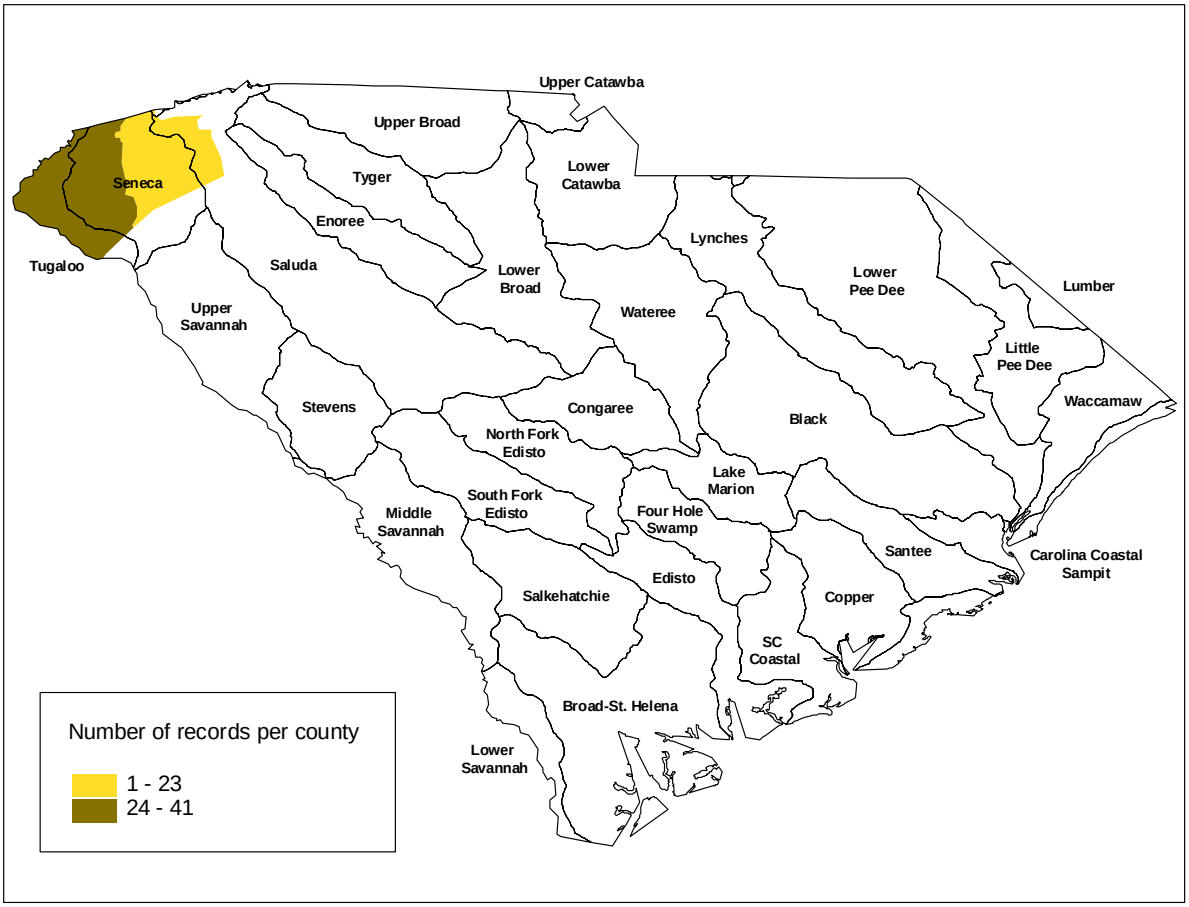

Figure 34. County based distribution of *Cambarus chaugaensis* within USGS Hydrologic Cataloging Unit Boundaries. Number of records per county based on USNHM and other collection records.

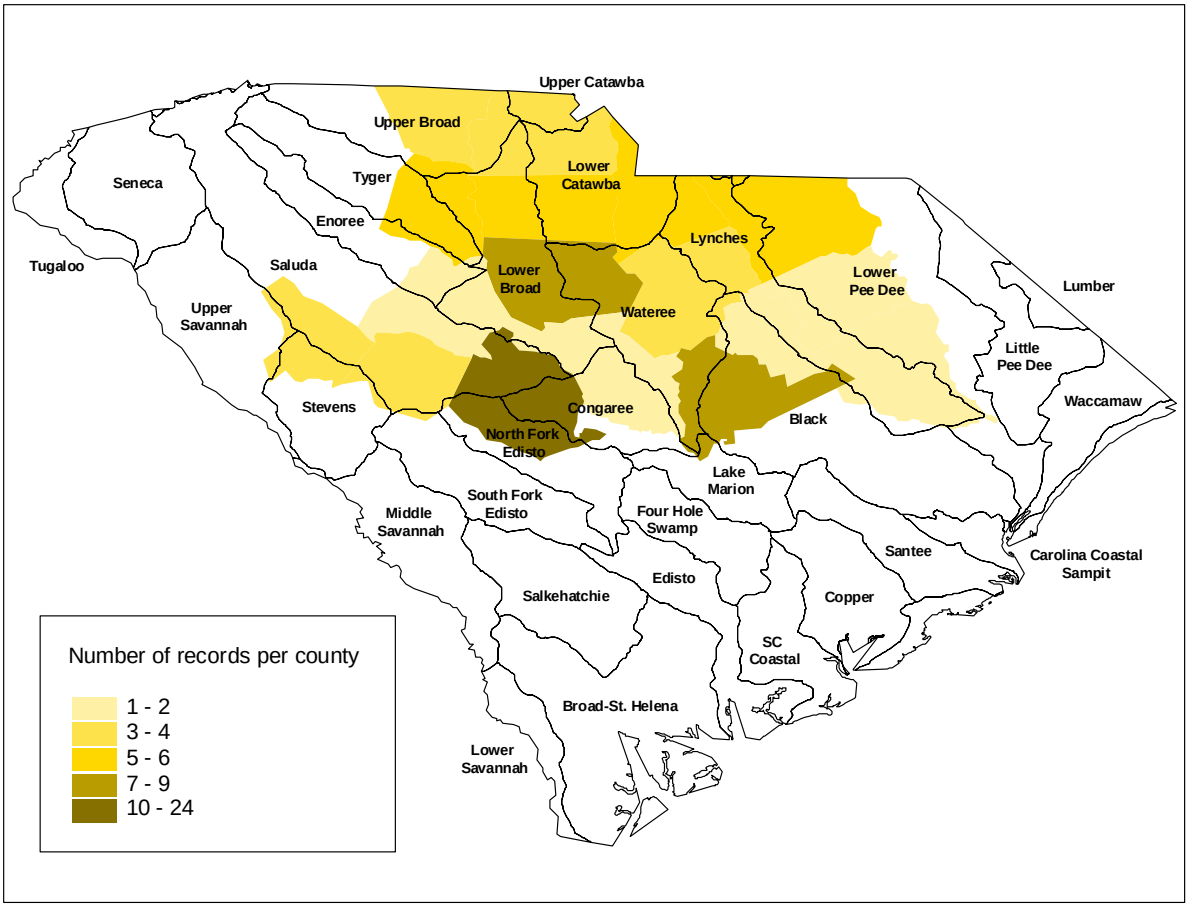

Figure 35. County based distribution of *Cambarus reduncus* within USGS Hydrologic Cataloging Unit Boundaries. Number of records per county based on USNHM and other collection records.

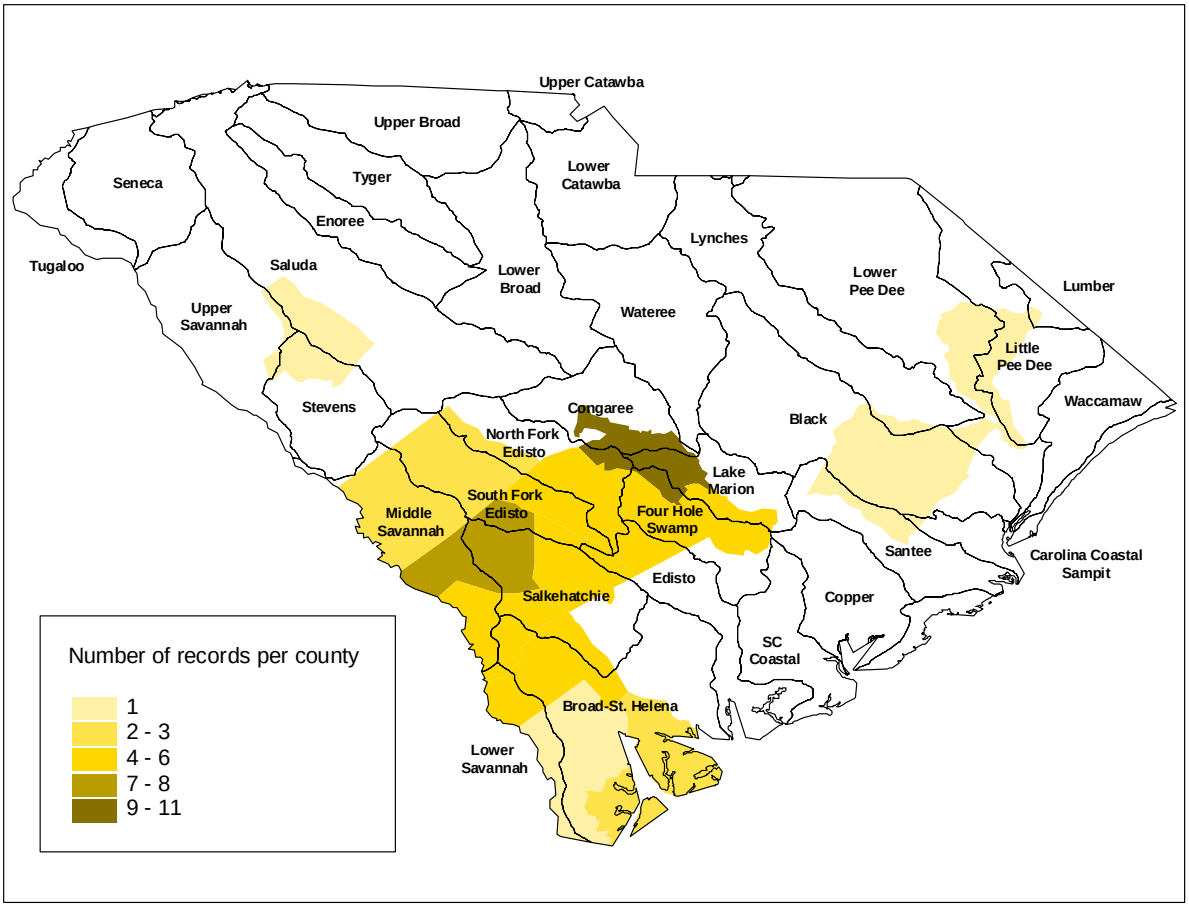

Figure 36. County based distribution of *Cambarus reflexus* within USGS Hydrologic Cataloging Unit Boundaries. Number of records per county based on USNHM and other collection records.

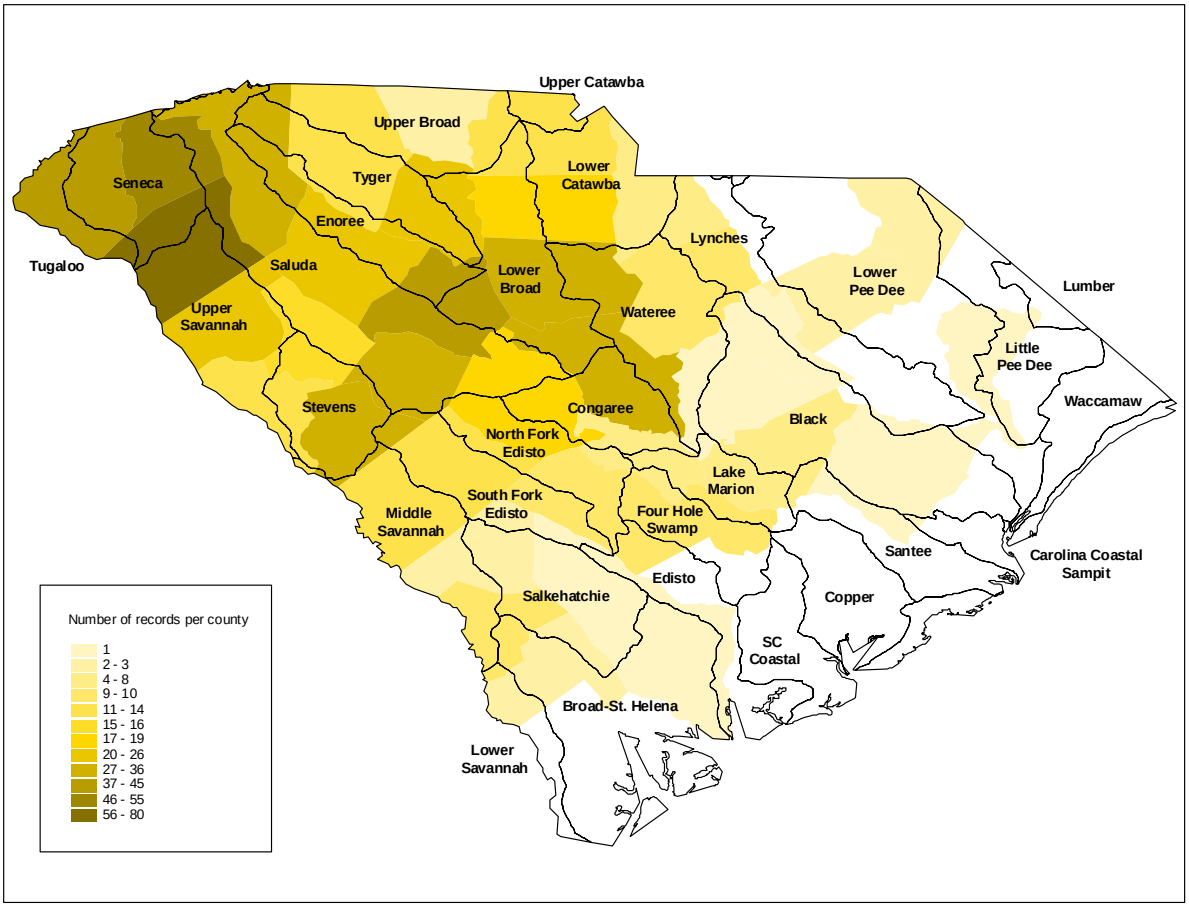

Figure 37. County based distribution of *Cambarus latimanus* within USGS Hydrologic Cataloging Unit Boundaries. Number of records per county based on USNHM and other collection records.

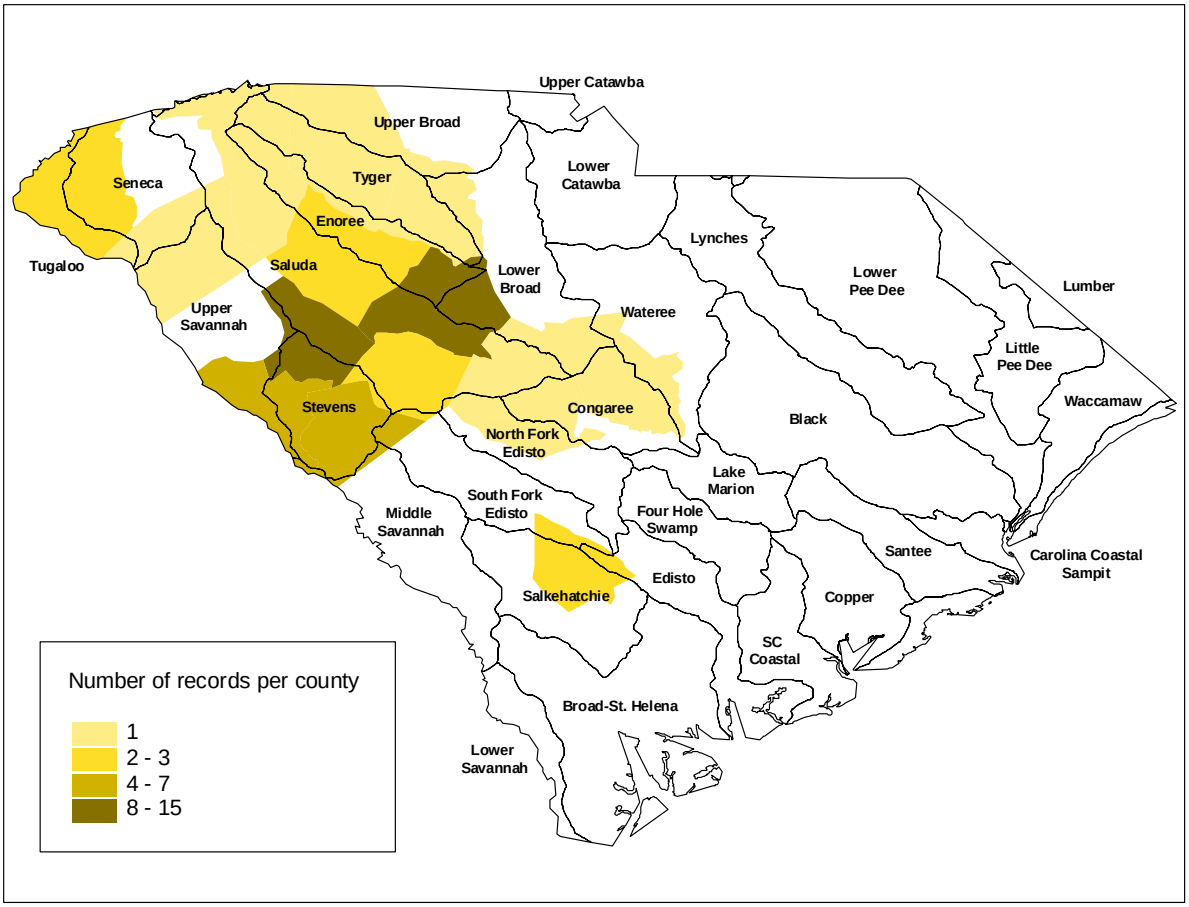

Figure 38. County based distribution of *Cambarus striatus* within USGS Hydrologic Cataloging Unit Boundaries. Number of records per county based on USNHM and other collection records.